RHODE ISLAND ATTAINMENT PLAN for the

ONE-HOUR OZONE NATIONAL AMBIENT AIR QUALITY STANDARD

Proposed January 2003

Rhode Island Department of Environmental Management
Office of Air Resources

Table of Contents

I. Introduction

The Clean Air Act Amendments of 1990 (CAA) required Rhode Island and other areas that are in serious nonattainment of the one-hour National Ambient Air Quality Standard (NAAQS) for ozone to submit State Implementation Plan (SIP) revisions by November 1994 demonstrating that those areas would attain the NAAQS by November 1999.

Rhode Island, like other northeast states, found it impossible to make that demonstration in 1994. As is the case throughout the northeast, Rhode Island's air quality is highly affected by the transport of ozone and ozone precursor emissions into the State from upwind areas. Some of those upwind areas are classified as severe nonattainment areas with attainment deadlines after 1999 and, therefore, did not plan to fully implement emissions control programs until after 1999. Other upwind areas did not have local ozone problems and did not plan to reduce their emissions. Rhode Island and neighboring states concluded that achieving attainment would be impossible without significant upwind emissions reductions.

In response to this dilemma, the U.S. Environmental Protection Agency (EPA) issued a policy in March 1995 delaying the CAA attainment demonstration submission deadlines to allow states and the EPA time to confer about transport issues. To address this issue, the Environmental Council of the States (ECOS) formed the Ozone Transport Assessment Group (OTAG), which was comprised of 37 eastern states. OTAG first convened in May 1995 and spent two years evaluating the causes and extent of ozone transport and discussing regional transport solutions. In July 1997 OTAG made a series of recommendations to EPA concerning a regional ozone reduction strategy.

In October 1998 EPA published a Federal Register notice entitled "Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone" (the "NOx SIP Call," 62 FR 60318), which adopted many of the OTAG recommendations. EPA found in that ruling that emissions of oxides of nitrogen (NOx) in 22 states and the District of Columbia contributed significantly to nonattainment of the one-hour ozone NAAQS in downwind areas. The NOx SIP Call required each of the 23 jurisdictions (subsequently reduced to 19) to submit a SIP revision limiting emissions of NOx, a class of ozone precursors, thereby eliminating that jurisdiction's significant contribution to downwind nonattainment. The EPA's action was consistent with section 110(a)(2)(D) of the CAA, which requires state SIPs to contain provisions that ensure that the state does not contribute significantly to nonattainment or interfere with maintenance of a NAAQS in another state.

The NOx SIP Call is expected to reduce summer time (May 1 – September 30) NOx emissions from electric generating units by approximately 64% by May 31, 2004 and to provide additional emissions reductions from other NOx sources such as non-utility industrial boilers and internal combustion engines. Serious nonattainment areas that are affected by transport, like Rhode Island, were required to submit attainment demonstrations by 1998 that took into account the NOx SIP Call requirements.

During the 1996-98 period, however, Rhode Island ozone monitors recorded only one exceedance of the one-hour NAAQS. Since the NAAQS is not violated unless four or more exceedances are recorded at a monitor during a three consecutive year period, Rhode Island was, at that time, in monitored attainment of that standard. Because of this status, EPA did not require the State to submit an attainment demonstration in 1998.

To reclassify nonattainment areas to attainment, states normally must submit documentation that demonstrates that monitored attainment in that area is the result of permanent verifiable emissions reductions and must submit a maintenance plan demonstrating that those benefits will be maintained. However, as part of a strategy for transitioning to the generally more stringent 8-hour ozone NAAQS, which was promulgated in 1997, EPA decided in 1998 to relax those requirements for areas that were in monitored attainment of the one-hour standard.

On June 9, 1999, EPA published a Federal Register notice revoking the applicability of the one-hour ozone NAAQS in several nonattainment areas, including Rhode Island, which were in monitored attainment. Rhode Island was, at that point, no longer an ozone nonattainment area, since the one-hour NAAQS no longer applied in the State and designations relative to the eight-hour NAAQS had not (and still have not) yet been made.

On July 20, 2000, EPA, concerned about litigation that threatened the timely implementation of the eight-hour NAAQS, reinstated the applicability of the one-hour NAAQS in Rhode Island and in the other areas in which it had been revoked. With this EPA action, Rhode Island once again was classified as an ozone nonattainment area. Since the State was still in monitored attainment of the one-hour ozone NAAQS, however, it was classified by the EPA as a clean data area and was not required to submit an attainment demonstration at that time. In June 2001, to resolve a suit brought by the Natural Resources Defense Council (NRDC) and the Sierra Club concerning the lack of approved attainment demonstrations in certain nonattainment areas, EPA agreed to a Consent Decree which sets deadlines by which EPA must approve attainment demonstrations or impose Federal Implementation Plans in Rhode Island, Massachusetts and New Hampshire in the event that the one-hour NAAQS was again violated in those nonattainment areas.

In the summer of 2001, three exceedances of the one-hour ozone NAAQS were recorded by the ozone monitors in West Greenwich and East Providence, Rhode Island and two exceedances were recorded at the Narragansett, Rhode Island monitor. Those exceedances brought the total number of exceedances in the 1999-2001 three-year period to four for the West Greenwich and East Providence monitors and five for the Narragansett monitor. Therefore, all three of the Rhode Island monitors were again monitoring a violation of the one-hour standard, which allows only three exceedances in a three-year period. These violations triggered the attainment demonstration submittal requirement in the EPA/NRDC/Sierra Club Consent Decree. According to the schedule specified in that agreement, the EPA must approve an attainment demonstration for Rhode Island by March 31, 2003. This document will serve as that attainment demonstration.

This attainment demonstration addresses the one-hour ozone NAAQS only. Although formal designations have not yet been made relative to the eight-hour NAAQS, monitoring data from throughout the State show that Rhode Island is also in violation of that standard. When the EPA promulgates a rule on implementation of the eight-hour ozone NAAQS in 2003 or later, Rhode

Island will comply with the requirements of that rule and implement any measures needed to achieve compliance with eight-hour standard.

II. Attainment Date

As discussed above, the Clean Air Act Amendments of 1990 required serious nonattainment areas to attain the one-hour ozone NAAQS by 1999. Rhode Island did attain the standard by that date, since the standard was not violated in the State during the 1996-98 through 1998-2000 periods. Further, in acknowledgement of the State's monitored attainment, EPA published a Federal Register notice in 1999 stating that the one-hour NAAQS no longer applied in Rhode Island. Therefore, when that standard was reinstated in the State and monitored violations of the standard were subsequently recorded, Rhode Island became a new ozone nonattainment area. Section 172 of the CAA specifies that new nonattainment areas must attain the applicable standard "as expeditiously as practicable."

RI DEM cannot ensure that the State will attain the one-hour NAAQS before 2007 and, therefore, is requesting that EPA agree that the year 2007 is the most expeditious attainment date practicable and deem that date to be Rhode Island's attainment deadline. 2007 is an appropriate attainment deadline for several reasons:

- A number of programs that will reduce emissions of ozone precursors in Rhode Island and in upwind areas will be implemented in 2004 and subsequent years. Programs that will reduce ozone precursor emissions in the coming years include:

  - EPA's NOx SIP Call budget program, which will be fully implemented in the eastern states that affect Rhode Island by 31 May 2004;

  - EPA's Tier 2 standards, which will impose new tailpipe standards for motor vehicles and reduce the sulfur content of fuel; phase-in of these standards will begin in 2004;

  - EPA's NOx emissions requirements for highway heavy-duty engines (i.e., trucks and buses), which will require new diesel trucks and buses to be 50 percent cleaner than today's models by 2004;

  - EPA began implementing new non-road diesel NO_x standards in 1996; these standards will become increasingly more stringent through 2006; and

  - A number of upwind states in the Ozone Transport Region are presently adopting additional regulations to control VOC emissions from architectural coatings, consumer products and other source categories; those measures will go into effect in 2004.

- The CAA attainment deadline for the severe nonattainment areas in New York and New Jersey, two states with emissions that substantially impact Rhode Island's ozone levels, is 2007. Implementation of emissions control programs in those states has been scheduled to allow those areas to attain the standard by 2007, so the effects of these programs will not be fully realized before that date.

- EPA recently approved a request from Massachusetts to extend the attainment deadline in the Eastern Massachusetts Nonattainment Area, which is immediately adjacent to Rhode Island, to 2007. EPA's arguments for approval of that date, published in the 15 October 2002 Federal Register (FR67:63586) are equally applicable to Rhode Island.

Rhode Island's ability to attain the one-hour NAAQS by 2007 is contingent on the implementation of the NOx SIP Call and the Federal on-road and non-road mobile source emissions reductions programs enumerated above, as promulgated. Program changes such as a modification of the New Source Review program could affect the conclusions of this analysis if those changes affect those emissions reductions.

III. EPA's Attainment Submittal Guidance Requirements

EPA guidance issued on December 29, 1997 entitled "Guidance for Implementing the 1-Hour Ozone and Pre-Existing PM_{10} NAAQS" lists the elements that must be included in an attainment demonstration. The four required elements delineated in that guidance document are included in this document. Those elements are as follows:

1. ***Evidence that all measures and regulations required for the nonattainment area by subpart 2 of Title I of the CAA to control ozone and its precursors have been adopted and implemented or are on an expeditious schedule to be adopted and implemented.*** Rhode Island has adopted and implemented the measures and regulations required for serious nonattainment areas in subpart 2, as delineated in Table 1, below.

2. ***A list of measures and regulations and/or a strategy including technology forcing controls needed to meet Rate of Progress (ROP) requirements and attain the 1-hour NAAQS.*** The measures adopted pursuant to ROP requirements are listed in Table 1, below. Additional measures that will be adopted in the State by 2005 are listed in Table 2. Although the Table 2 measures are not necessary for the State to attain the one-hour NAAQS, they may help Rhode Island and downwind areas to attain the eight-hour ozone NAAQS.

3. ***A SIP commitment and schedule to implement the control programs and regulations in a timely manner to meet ROP and achieve attainment.*** Once approved, this submittal will serve as Rhode Island's commitment to continue to implement programs and regulations in a timely manner to meet ROP and achieve attainment. The commitment to attain the standard by 2007 is conditioned on the full implementation of the Federal NOx SIP Call and Tier2/Low Sulfur Gasoline programs in accordance with the current schedule. Rhode Island also commits to performing a mid-course review by December 31, 2004, pursuant to EPA requirements and guidance, to determine whether Rhode Island is on track to attain by 2007.

4. ***Evidence of a public hearing on the State submittal***. Rhode Island held a public hearing on the proposed submittal in February 27, 2003. A certification that a public hearing was held will be included in the formal submission to EPA of the final SIP revision.

Table 1
Control Measures in the Rhode Island Ozone Serious Nonattainment Area

Name of Control Measure	Type of Measure	Approval Status
On-board Refueling Vapor Recovery	Federal rule	Promulgated at 40 CFR 86
Federal Motor Vehicle Control program (Tier 0)	Federal rule	Promulgated at 40 CFR 86 (pre-1990)
National Low Emission Vehicle (NLEV)	Federal voluntary rule, State opt-in	
Heavy Duty Diesel Engines (On-road)	Federal rule	Promulgated at 40 CFR 86
Federal Non-road Heavy Duty diesel engines	Federal rule	Promulgated at 40 CFR 89
Federal Non-road Gasoline Engines	Federal rule	Promulgated at 40 CFR 90
Federal Marine Engines	Federal rule	Promulgated at 40 CFR 91
Rail Road Locomotive Controls	Federal rule	Promulgated at 40 CFR 92
AIM Surface Coatings	State Initiative Contingency Regulation	SIP approved (61 FR 55903; 10/30/96)
Consumer & commercial products	State Initiative Contingency Regulation	SIP approved (61 FR 55903; 10/30/96)
Automotive Refinishing	State Initiative Regulation	SIP approved (61 FR 3827; 2/2/96)
Enhanced Motor Vehicle Inspection	CAA SIP requirement-DMV Regulation No. 1	SIP approved (66 FR 9663; 2/9/01)
NOx RACT	CAA SIP requirement-Regulation No. 27	SIP approved (62 FR 46202; 9/2/97)
VOC RACT pursuant to sections 182(a)(2)(A) and 182(b)(2)(B) of CAA	CAA SIP requirement	SIP approved (59 FR 52429;10/18/94)

Name of Control Measure	Type of Measure	Approval Status
VOC RACT pursuant to section 182(b)(2)(A) and (C) of CAA	CAA SIP requirement	Partially SIP Approved (64 FR 67500, 12/2/99). EPA approval pending for certain non-CTG RACT determinations. Marine Vessel SIP Approved (61 FR 14975, 4/4/96)
Stage II Vapor Recovery	CAA SIP requirement	SIP Approved (58 FR 65933; 12/17/93)
Reformulated Gasoline	State opt-in	SIP approved (65 FR 12476, 3/9/00)
Clean Fuel Fleets	CAA SIP requirement	SIP approved (65 FR 12476, 3/9/00) Rhode Island used RFG reductions to meet the Clean Fuel Fleet requirement.
Base Year Emissions Inventory	CAA SIP requirement	SIP approved (61 FR 55902; 10/30/96, amended 63 FR 67600, 12/8/98)
15% VOC Reduction Plan & Contingency Plan	CAA SIP requirement	SIP approved 63 FR 67594, 12/8/98)
9% rate of progress plan	CAA SIP requirement	SIP approved (66 FR 30811, 6/8/01)
Emissions Statements	CAA SIP requirement	SIP approved (60 FR 2526; 1/10/95)
Enhanced Monitoring (PAMS)	CAA requirement	SIP approved (61 FR 55897; 10/30/96)
OTC NOx MOU Phase II	State initiative regulation	SIP approved (64 FR 29567; 6/2/99)
NOx SIP Call	EPA requirement	SIP approved (65 FR 81748, 12/27/00)

Table 2
Additional Control Measures in the Rhode Island Ozone Serious Nonattainment Area with Dates When Implementation is Anticipated

Name of Control Measure	Type of Measure	Status
OTC Model Rule on Portable Fuel Containers	State initiative	Implementation by 2005 per OTC Memorandum of Understanding
OTC Model Rule on architectural and maintenance coatings	State initiative	Implementation by 2005 per OTC Memorandum of Understanding
OTC Model Rule on consumer products	State initiative	Implementation by 2005 per OTC Memorandum of Understanding

IV. Absolute Modeling and the Need for Additional Evidence in Support of Attainment

The CAA requires that attainment demonstrations for serious nonattainment areas use photochemical modeling to demonstrate that those areas will attain the one-hour ozone NAAQS. A photochemical model is a set of mathematical equations that simulate the chemical and physical processes that affect the formation, transport and decay of airborne pollutants like ozone and that predict resultant concentrations of those pollutants. These models enable planning agencies to predict the effect of the implementation of emission control strategies on ambient pollutant concentrations.

In 1994, RI DEM collaborated with its counterpart agencies in Massachusetts, New Hampshire, Connecticut and Maine in the development of a photochemical modeling platform to simulate ozone episodes in a regional area referred to as the New England Domain. The area included in that Domain is shown in Figure 1. The platform used the EPA-approved Urban Airshed Model (UAM-IV) and showed that emission reductions mandated by the CAA to be in place by 1999 (i.e., no controls beyond those in the 9% Rate of Progress plans) would not be sufficient to bring Rhode Island and the other states in the Domain into attainment with the one-hour ozone NAAQS. The UAM-IV 1999 CAA control strategy model results for all four episodes modeled showed predicted exceedances over substantial portions of Rhode Island.

Although the UAM-IV model performance met EPA's measures of acceptability, the New England Domain was concerned about the model's handling of plume transport along coastal Maine and New Hampshire, where monitored ozone exceedances were not replicated with the model. An alternative modeling platform using the CALGRID[1] model was thus investigated. Performance evaluation runs indicated that CALGRID performance was better than that of UAM-IV in New England, particularly in coastal New Hampshire and Maine, and, in November 1997, EPA approved the use of CALGRID for predicting one-hour ozone concentrations in the New England Domain.

A. 1999 Modeling Runs – Clean Air Act Controls

The New England Domain then performed a suite of model runs with the CALGRID model to evaluate the effectiveness of mandated CAA controls. The 1999 modeling runs used emission inventory files reflecting the implementation of all controls mandated by the CAA to be in effect by 1999 in the Domain, coupled with boundary condition files that were extracted from EPA region-wide modeling runs for 1999. Five historic ozone episodes were modeled: August 15, 1987, August 17, 1987, June 22, 1988, July 8, 1988, and July 11, 1988. The maximum predicted ozone concentrations for those episode days, after implementation of 1999 CAA controls, are shown in Figures 2-6. The model predicted exceedances of the ozone NAAQS (125 ppb) in and

[1] The CALGRID model, designed by Earthtech (Concord, Massachusetts), is a modular photochemical model with significant improvements in atmospheric physics and chemistry beyond UAM-IV. Improvements include: ozone deposition removal scheme including stomata resistances of the vegetative canopy; inclusion of cloud observations to determine spatial and temporal solar insolation; and the capacity for additional mixing layer sat user-defined levels for improved air/sea interface ozone predictions

downwind of Rhode Island for all five days, indicating that implementation of the 1999 minimum CAA controls would not be sufficient for Rhode Island to attain the one-hour NAAQS.

B. 1999 Modeling Runs – Sensitivity Analysis

Domain modelers performed a suite of CALGRID model runs designed to determine whether the ozone levels in the Domain are more sensitive to reductions in VOC or NOx. Both of these pollutant classes are ozone precursors but, depending on the relative concentrations of the two types of pollutants present and other factors that affect photochemistry, reductions of emissions of one of these pollutants may be more effective than the other in reducing one-hour average ozone levels in a particular region. As can be seen in Figures 7-11, for all five episodes, zeroing out anthropogenic NOx emissions in the Domain dramatically reduced ozone levels, while zeroing out anthropogenic emissions of VOC had little benefit. Note that the NOx reductions in the Domain were less effective in reducing ozone levels in Rhode Island than in other parts of the Domain. This is due to the proximity of Rhode Island to the upwind boundary of the Domain and implies that areas upwind of the modeling boundary domain are important contributors to Rhode Island's ozone problem. Based on these results, the remainder of the modeling analysis focused on NOx, rather than VOC emissions reductions.

C. 2007 Modeling Runs

Domain modelers then performed a set of CALGRID runs for the two July 1988 episodes to determine whether the emissions reductions associated with EPA's proposed NOx SIP Call would be sufficient to eliminate modeled exceedances of the one-hour NAAQS in the Domain. The runs employed 2007 NOx SIP Call emission reductions inside the New England Domain, along with boundary conditions files reflecting NOx SIP Call emission estimates in upwind areas. See Table 3 for a summary of the 1999 and 2007 NOx emissions data for each state utilized in the modeling. Boundary condition files were extracted from OTAG Run I, which EPA has determined to be a reasonable surrogate for 2007 NOx SIP Call emission reductions in upwind areas. Modeling runs could not be performed for the other three episodes because OTAG did not perform modeling runs for those episodes that could be used to generate boundary conditions.

The maximum hourly 2007 modeling results for the two July episodes are shown in Figures 12 and 13. The differences between those ozone levels and those in the 1999 CAA runs for those days are also displayed in those figures. The model predicts, for the July 11, 1988 episode, that implementation of the NOx SIP Call would substantially reduce the ozone plume in the southwest portion of the Domain (Figure 12), resulting in an elimination of ozone exceedances in Rhode Island. For the July 11 episode (Figure 13), the NOx SIP Call reductions also resulted in a reduction in the ozone plume in the southwest portion of the Domain; however, a substantial portion of Rhode Island continued to exceed the one-hour ozone NAAQS in that episode.

Table 3
NOx Emission Files for New England Domain Modeling Runs

State	1999 CAA	2007 SIP Call	Reduction
Connecticut	372.6	313.2	15.90%
Maine	157.3	153.58	2.40%
Massachusetts	712.7	620	13.00%
New Hampshire	187.3	151.4	19.20%
Rhode Island	94.5	61.8	34.60%
Vermont	56.1	77.8	-38.70%
TOTAL	1580.5	1377.78	**12.8%**

D. The Need for Additional Evidence

The photochemical modeling results discussed above indicate that EPA's NOx SIP Call will be effective in reducing ozone concentrations in Rhode Island and the rest of the New England Domain. However, the absolute modeling results continue to show exceedances for the July 11,1988 episode after implementation of the NOx SIP Call, and thus do not meet the strict deterministic test for showing attainment of the one-hour NAAQS in Rhode Island.

Using photochemical ozone modeling results in the absolute sense to demonstrate attainment is a conservative procedure. The strict deterministic test for demonstrating attainment using the absolute results requires all ozone exceedances to be eliminated during every episode and for every cell in the nonattainment area. This is an extremely demanding test, particularly for severe ozone episodes such as occurred on July 11, 1988. This test also does not account for the statistical nature of the ozone standard, which allows for up to three exceedances at each monitor during a three-year period.

Accordingly, EPA has issued guidance that allows states to use a "weight of evidence" approach to demonstrate attainment of the one-hour ozone NAAQS when modeling alone does not demonstrate attainment. This approach recognizes the uncertainties inherent in photochemical modeling and permits the use of additional evidence to demonstrate whether attainment is likely to be achieved.

The following additional evidence is provided below:

1. Evidence from trajectory, photochemical and source apportionment models that NOx emissions in upwind states are the major cause of Rhode Island's elevated ozone levels.

2. Emissions inventories for Rhode Island and upwind areas showing that substantial reductions in ozone precursor emissions will occur by 2007.

3. Evidence from analyses of the relative reductions in ozone levels associated with the NOx SIP Call, the additional benefits associated with implementation of the Tier 2/Low Sulfur Gasoline program and ozone design value trends that upcoming emissions reductions will be sufficient for Rhode Island to achieve attainment by 2007.

In its entirety, this evidence demonstrates that Rhode Island will attain the one-hour ozone NAAQS by 2007, after the NOx SIP Call and the Tier 2/Low Sulfur Gasoline programs are fully implemented.

V. Additional Evidence Demonstrating Attainment

A. NOx Emissions in Upwind States are the Major cause of Elevated One-Hour Ozone Levels in Rhode Island.

Several lines of evidence demonstrate that NOx emissions in upwind states contribute substantially to elevated ozone levels in Rhode Island. This evidence follows.

1. Ozone Exceedance Day Trajectory Analysis

Trajectory analysis modeling is a tool that can be used to assess atmospheric transport and to identify the geographical areas that are the likely source of locally elevated transport-associated air contaminants. RI DEM used the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT-4) model, which was developed by the National Oceanic and Atmospheric Administration's (NOAA's) Air Resources Lab, to compute backward trajectories for days that Rhode Island experienced exceedances of the one-hour NAAQS. Backward trajectories map the path that an airmass has followed during the 24-hour period leading up to the ozone level elevation. Input meteorological data fields from the National Centers for Environmental Prediction (NCEP) Eta Data Assimilation System (EDAS)[2] were used. HYSPLIT can calculate up to three simultaneous trajectories at user-selected start elevations, a useful feature since pollutant transport occurs through the entire depth of the planetary boundary layer, which commonly extends from the ground to well above 1000 meters elevation.

The backward trajectories for each of the ten days that the one-hour ozone NAAQS (125 ppb) was exceeded during the1999-2002 period are shown in Figures 14-23. Each graphic depicts three trajectories, corresponding to start elevations of 10, 500, and 1000 meters, each beginning at the hour that the peak concentration was recorded and at the monitor recording the highest one-hour ozone level that day.

Trajectories for the ten exceedance days exhibit similar patterns, suggesting a consistency of meteorological pattern and source region for ozone and precursors. The surface-based trajectories (10 meter elevations), which are indicators of shorter range transport, follow a general track that crosses near the New York City/New Jersey metropolitan area before turning northeastward toward Rhode Island. These trajectories do not cross high emission areas in Rhode Island. Upper level trajectories (500 and 1,000 meters elevation), which are indicators of longer range transport, generally begin farther west over New York state, Pennsylvania or Ohio and follow a more west-to-east track, passing north of the New York Metro area.

To better understand what drives ozone exceedances in the State, RI DEM compared back trajectories in Rhode Island to those associated with a neighboring area that sometimes experiences substantially different ozone levels than those in the State. For this analysis, RI DEM chose to compare back trajectories for Narragansett, Rhode Island with those for Worcester, Massachusetts. Note that Rhode Island's small size and relatively uniform climactic conditions made it impossible to select an in-state comparison site for this analysis.

---

[2] Information on HYSPLIT and the EDAS system can be found at http://www.arl.noaa.gov/ready.html

RI DEM identified two days in the 1999-2001 period when the maximum one-hour ozone concentrations at the Narragansett site were more than 60 ppb higher than those in Worcester, and two days in the same time period when the Worcester site was higher than Narragansett by more than 60 ppb. The near-surface back trajectories for the two sites for each of the four days were then compared (Figures 24-27).

The trajectories for 7 June 1999 and 7 August 2001, the two days when the Narragansett levels were more than 60 ppb higher than the Worcester levels, show that the Narragansett near-surface airmasses on those days originated in the New York City/New Jersey metropolitan area, while the Worcester airmass came from the west or northwest, north of the high emitting New York areas. (Figures 24 and 25). In contrast, on 17 August 1999 and 24 July 2001, when the Worcester ozone levels were far higher than those in Narragansett, the airmass affecting Worcester passed through the New York City/New Jersey metropolitan area while the Narragansett trajectory remained offshore, east of the high emitting areas. (Figures 26 and 27). These comparison results support the thesis that pollutants emitted in the New York City/New Jersey metropolitan area contribute substantially to elevated ozone levels in this region.

2. Photochemical modeling results

As discussed above, the absolute results of the CALGRID modeling of the implementation of the NOx SIP Call do not meet the strict deterministic test for demonstrating attainment in Rhode Island. However, the modeling does show that the implementation of the NOx SIP Call in upwind areas would dramatically reduce ozone levels in the State. Using CALGRID, the Domain modeled the effects of implementation of the NOx SIP Call in upwind areas (OTAG Run I boundary conditions) while emissions within the Domain remained at the 1999 Clean Air Act levels. The results of these runs for the July 8 and 11, 1988 episodes are shown in Figures 28 and 29, respectively. Note that the CALGRID runs for 2007 include the benefits of the NOx SIP call as well as other CAA measures, but did not account for EPA's Tier2/Gasoline Sulfur program, which will further reduce ozone levels by 2007.

These modeling results show that implementation of NOx emissions reductions in upwind areas, even without similar reductions in the Domain, would eliminate all ozone exceedances in Rhode Island for the July 8 episode and substantially reduce both the severity and the extent of ozone exceedances in the State for the July 11 episode. For the July 11 episode, the addition of the NOx SIP Call controls in the Domain does not result in further ozone reductions in Rhode Island beyond those associated with the NOx SIP Call reductions in the upwind area only. In fact, even a 100% reduction in anthropogenic emissions in the Domain would not substantially further reduce ozone levels in the State beyond the reductions associated with the upwind controls. (See Figure 30.)

3. CAMx Source Apportionment Modeling

The EPA conducted source apportionment modeling, using the CAMx model, which further substantiates this thesis. That analysis, which was described in EPA's October 27, 1998 Final Rulemaking on the NOx SIP Call, examined the influence of emissions in upwind areas on downwind one-hour nonattainment areas. The analysis showed that 54% of the total anthropogenic ozone in the Rhode Island Nonattainment Area, averaged across all episodes studied, was caused by emissions in New Jersey and New York. Emissions in Pennsylvania, Ohio, Virginia and West Virginia together caused 29% of Rhode Island's anthropogenic ozone. Rhode Island and Connecticut emissions together contributed only 5% to these levels. (See Figure 31 for individual states' contributions to Rhode Island's anthropogenic ozone.)

4. Effect of Upwind NOx Emissions - Summary

The results of the trajectory, photochemical and source apportionment models, taken together, provide substantive evidence that upwind NOx emissions, particularly those in the New York City/New Jersey area, are the primary determinant of ozone concentrations in Rhode Island.

B. Substantial Emissions Reductions Will Occur Between 2002 and 2007

Substantial emissions reductions will occur in both Rhode Island and in upwind areas between 2002 and 2007.

1. NOx Emissions Reductions in Upwind States

Table 4 presents 1999 NOx emissions inventories for the New York and New Jersey portions of the New York City (NYC) metropolitan area, as well as for the remainder of New Jersey and for Connecticut. Projected inventories for 2002 and 2007 for those upwind areas are also presented in that table. The inventories show that, with the implementation of the NOx SIP Call, the Tier II program and other control strategies, NOx emissions in those areas are expected to be reduced by 14.9% between 2002 and 2007. NOx emissions in the NYC metropolitan area, which substantially affect ozone levels in Rhode Island, are expected to decrease by 10.9% during that period.

Since these expected emissions reductions are largely the results of federal or federally mandated programs, similar reductions can be expected in the other upwind states that substantially impact Rhode Island's ozone concentrations; Pennsylvania, Ohio, Virginia and West Virginia.

Table 4
NOx Emission Inventories in Tons per Summer Day (tpsd) for Connecticut, New York City, and New Jersey

State	1999	2002	2007	2002-2007 Reduction (tpsd)	2002-2007 Reduction (%)
Connecticut	401.2	374.0	294.3	79.7	21.3
NY portion of NYC metro area[3]	753.0	684.1	619.0	65.1	9.5
NJ portion of NYC metro area[4]	631.1	573.5	501.6	71.9	12.5
Remainder of New Jersey[5]	345.5	326.3	251.2	75.1	23.0
TOTAL	2130.8	1957.9	1666.1	291.8	14.9
TOTAL for NYC metro area	1384.1	1257.6	1120.6	137.0	10.9

2. Emissions Reductions in Rhode Island

As discussed above, NOx emissions reductions in upwind areas have substantial impacts on one-hour ozone concentrations in Rhode Island, while emissions reductions in Rhode Island do not substantially impact one-hour maximum ozone levels in the State. It is important, however, that Rhode Island's emissions of ozone precursors be minimized in order to minimize the impact of those emissions on ozone levels in the State and in downwind areas, like Massachusetts, New Hampshire and Maine.

The CAA required serious nonattainment areas, like Rhode Island, to submit SIP revisions called Rate of Progress analyses (ROPs) demonstrating that emissions of VOC in those areas would be reduced by at least 15% by 1996 and that emissions of VOC and/or NOx would be reduced by an additional 9% by 1999. Rhode Island implemented a number of emissions control programs, as listed in Table I, to meet those requirements and submitted its ROP plans in a timely manner. The State's 1996 and 1999 ROPs, which demonstrated an emissions decrease in excess of 18% between 1990 and 1999, were approved into Rhode Island's SIP on 8 December 1998 and 8 June 2001, respectively.

---

[3] 2002 and 2007 data is from NY post-1999 rate-of-progress plan. 1999 data provided by NY DEC.
[4] 2002 and 2007 data is from New Jersey SIP "1996 Actual Emission Inventory and Rate of Progress (ROP) Plans for 2002, 2005 and 2007," December 31, 2000. 1999 data provided by NJ DEP.
[5] The December 2000 NJ ROP plan did not contain a 2007 emissions estimate for on-road for the Atlantic City nonattainment area, and the NJ portion of the Philadelphia and Allentown/Bethlehem/Easton nonattainment areas. The 2007 on-road emissions for these areas were based on the 2005 on-road emissions estimates.

RI DEM, in conjunction with EPA Region I, has updated the State's 1999 emissions inventory and has projected that inventory to the years 2002 and 2007. The Rhode Island VOC and NOx emissions inventories for 1999, 2002 and 2007 shown in Table 5.

Table 5
Rhode Island VOC and NOx Emission Inventories in Tons per Summer Day (tpsd)

Source Category	VOC			NOx		
	1999	2002	2007	1999	2002	2007
Stationary Point[6]	11.0	11.5	12.0	8.0	8.3	8.9
Stationary Area	46.7	49.6	54.2	1.5	1.5	1.3
On-road Mobile[7]	52.3	39.3	31.0	52.2	46.3	33.6
Non-road Mobile	31.1	28.6	21.8	31.4	31.2	29.8
Total	141.1	129.0	119.0	93.1	87.3	73.6

2007 VOC emissions in the State are projected to be 16% lower than 1999 emissions and 8% lower than 2002 emissions. Similarly, 2007 NOx emission projections are 21% lower than 1999 emissions and 16% lower than 2002 projections. The methodology used to calculate these inventories is discussed in Appendix A.

While stationary point and area source VOC emissions are projected to increase somewhat between 1999 and 2007, emissions reductions on-road and non-road mobile sources more than offset those increases. These VOC emissions reductions are the result primarily of the implementation of the Enhanced Motor Vehicle Inspection/Maintenance program, the National Low Emissions Vehicle program, Tier 2 Tailpipe controls, Phase II Reformulated Gasoline, the Heavy Duty Diesel Standard, and the Phase II Small engine standard.

Since Rhode Island's power plants are all relatively new, low emitting facilities, no additional point source NOx emissions reductions are projected in the State as the result of the implementation of the NOx SIP Call. Therefore, as with VOC, projected NOx emissions reductions are primarily associated with the on-road and non-road mobile source emissions control programs listed above. Note that these programs are stringent enough that they will substantially reduce NOx and VOC on-road mobile source emissions between 1999 and 2007, even though vehicle miles traveled numbers are expected to substantially increase during that time period.

[6] Point sources are stationary source of air pollution, primarily manufacturing facilities and power plants that emit more than 10 tons per year of VOC or 25 tons per year of NOx. Area sources are smaller stationary sources, including small surface coaters, dry cleaners, small boilers and the use of consumer products. Area sources are too small to be accounted for individually, but, taken in the aggregate, may emit substantial amounts of pollutants. On-road mobile sources include cars, sports utility vehicles, trucks, motorcycles and buses. Non-road sources are engines that are usually not operated on a road, such as construction equipment, boats, recreational equipment, lawnmowers, etc.

[7] Includes VOC refueling loss of 1.06 tpsd for 1999, 0.78 tpsd for 2002 and 0.63 tpsd for 2007

C. Expected Emissions Reductions Will Bring Rhode Island into Attainment by 2007

The following evidence demonstrates that the emissions reductions discussed above will be sufficient for Rhode Island to attain the one-hour ozone NAAQS by 2007.

1. Ozone Design Value Trends

Ozone concentrations in Rhode Island have trended downward over the last 15 years. Variations in meteorological conditions from year to year play a substantial role, however, in the number and magnitude of ozone exceedances in an individual ozone season. To minimize the implications of these variations, the ozone NAAQS is based on the number of exceedances in a three-year period.

Figure 32 shows the number of ozone exceedances for the three-year periods from 1984-86 through 2000-2002 at the West Greenwich monitor, the only monitor that operated continuously during that period. The exceedance rate decreased substantially during that time period, including a dramatic decrease in the early to mid 1990’s, which corresponds to the implementation of the emissions reductions mandated by the CAA. A slight increase in ozone exceedances occurred in the past two years, however, due to the occurrence of unusually hot summers.

Rhode Island’s design values (the fourth highest daily maximum one-hour ozone concentration in a three year period) for 1988 through 2001 for all ozone monitors in the State are displayed in Table 6 and, graphically, in Figure 33. Design values at or above the one-hour ozone NAAQS (125 ppb) are bolded in the table. As with the number of ozone exceedances, the design values generally decreased until 2000 and increased somewhat in 2001 and 2002 due to unusually hot ozone seasons.

Design values for ozone monitors downwind of Rhode Island (areas impacted by Rhode Island emissions) are presented in Table 7. Design values exceeding the ozone NAAQS are bolded. This table shows a decreasing number of design values exceeding the NAAQS over time, with New Hampshire ozone monitors attaining the one-hour ozone NAAQS by 1998 and Maine ozone monitors by 2000.

These trends suggest that the number and severity of ozone exceedances in Rhode Island and downwind areas are sensitive to emissions controls programs and that, with the reductions in emissions in Rhode Island and upwind states projected to occur between 2002 and 2007, ozone levels can be expected to continue to substantially decline.

Table 6
Rhode Island Design Values for the One-Hour Ozone NAAQS (ppb)

	W. Greenwich 44-003-0002	Providence 44-007-0012	E. Providence 44-007-1010	Narragansett 44-009-0007
1988	**162**	**138**		
1989	**162**	**135**		
1990	**148**	**125**		
1991	**152**	114		
1992	**150**	116		
1993	**150**	107		
1994	121	112		
1995	**135**	115		
1996	**133**	115	120	
1997	**133**	113	117	
1998	114		108	
1999	121		108	
2000	121		108	124
2001	**127**		**125**	**144**
2002	**130**		**127**	124

Note – Bolded values are violations of the one-hour ozone NAAQS.

Table 7
Design Values for the One-Hour Ozone NAAQS in Downwind Areas (ppb)

SITE ID	CITY	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Massachusetts															
25-025-0041	BOSTON														115
25-025-0042	BOSTON														94
25-025-1003	CHELSEA	**136**	**136**	**137**	122	122	115	111	111	106	95	95	105		
25-005-1005	EASTON	120	**132**	**129**	**132**	**127**	**127**	115	122	122	107	107	107	103	111
25-005-1002	FAIRHAVEN	**151**	**150**	**150**	**132**	**128**	122	109	120	120	**138**	118	123	118	**125**
25-009-0005	LAWRENCE	**126**	**126**	**125**	106	104	104	100	100	94	92	96	96	94	82
25-009-2006	LYNN							115	119	119	113	119	115	113	117
25-009-4004	NEWBURY	**139**	**139**	**139**	123	123	**128**	119	120	111	113	108	118	109	112
25-023-2001	SCITUATE	**136**	**133**	**133**	118	113	115	113	108	104	102				
25-017-1801	SUDBURY/STOW	**146**	**146**	**146**	122	116	**127**	117	125	113	109	107	111	108	116
25-001-0002	TRURO	**158**	**146**	**146**	**139**	**132**	**130**	116	124	**128**	**131**	124	124	119	**138**
25-017-4003	WALTHAM			113	**130**	**128**	124	101	108	104	108	113	113		
25-027-0015	WORCESTER	113	120	**127**	**127**	**125**	**139**	**136**	**130**	122	108	115	115	115	114
Southern New Hampshire															
33-013-0007	CONCORD							93	93	95	98	98	96	88	86
33-003-1002	CONWAY											78	83	78	87
33-001-2003	LACONIA											88	88	84	90
33-011-0016	MANCHESTER	122	122	122	97	98	101	100	100	101	103	103	100	89	89
33-011-1010	NASHUA	118	121	121	109	109	122	112	115	106	111	110	110	100	103
33-015-0009	PORTSMOUTH	**140**	**140**	**140**	118	118	113	108	113	113	117	108	112	108	98
33-017-3002	ROCHESTER											101	104	103	103
33-015-0012	RYE	**156**	**156**	**156**	**143**	**134**	**125**	118	**130**	**130**	**130**	120	123	118	123
Southern Maine															
23-005-2003	CAPE ELIZABETH	**156**	**156**	**150**	**141**	**137**	**128**	122	122	116	121	121	121	109	111
23-011-2005	GARDINER	119	**125**	**125**	108	107	104	98	98	98	98	102	102	100	100
23-031-2002	KENNEBUNKPRT	**152**	**152**	**152**	**152**	**148**	**134**	**127**	**129**	118	**125**	123	**125**	120	120
23-031-3002	KITTERY										**126**	114	115	104	117
23-013-0004	KNOX CO.	**149**	**143**	**143**	**134**	**129**	**129**	122	123	111	119	113	116	107	109
23-017-3001	OXFORD CO.							87	93	97	79	77	77	75	78
23-023-0003	PHIPPSBURG								**132**	124	**125**	124	124	111	

Note – Bolded values are violations of the one-hour ozone NAAQS.

2. Relative Analysis of Photochemical Modeling Results

As noted above, the EPA approved weight of evidence approach recommends using photochemical models in a relative manner when absolute model results do not meet the strict deterministic test for demonstrating attainment, as is the case in Rhode Island. RI DEM is using the modeling results in this relative way, to show that emissions reductions that will occur between 1999 and 2007 will result in 2007 one-hour ozone levels that comply with the NAAQS. The following is a three-step analysis describing how the photochemical modeling results, when applied to the ozone design values for the three Rhode Island monitors, predict attainment by 2007 after taking into account anticipated emission reductions from the NOx SIP Call and the Tier 2/Low Sulfur programs.

a. Base Year Ozone Design Values

Rhode Island's one-hour ozone design values for 1988 through 2002 for each of the Rhode Island monitors are presented in Table 6. Note that the West Greenwich monitor was the only Rhode Island monitor to operate continuously over that time period. Although the modeling analysis was performed for 1999, RI DEM will use the 1997 design values as its base for this analysis, because the design value did not exceed the NAAQS in 1998 or 1999. In 1997, the one-hour design value for the West Greenwich monitor was 133 and that at East Providence was 117 ppb. Note that, since the Narragansett monitor did not begin operation until midway through the 1997 ozone season, the first year for which a design value is available for that monitor is 2000. Therefore, the design value for 2000, 124 ppb, was used in this analysis for the Narragansett monitor.

b. Ozone Reduction between 1997 and 2007

Next, RI DEM used photochemical modeling results to estimate the ozone reduction that can be expected to occur at each ozone monitor in Rhode Island by 2007. As discussed above, modeling runs are available for 1999, but not for 1997, the design value base year. However, it is reasonable to use the 1999 modeling results as a surrogate for 1997 ozone levels because substantial emissions reductions did not occur between 1997 and 1999. Modeling results for 1999 were compared with those for 2007 to estimate the ozone reductions that will occur between 1997 and 2007 due to implementation of the NOx SIP Call.

RI DEM calculated the ozone levels predicted by the model for 1999 and 2007 for each monitoring site and for each of the two modeling episodes as the average of the predicted levels for the nine 5 by 5 kilometer surface cells surrounding the monitor locations. The change in ozone level between 1999 and 2007 for each monitor for each episode was then divided by the 1999 modeled concentration for that monitor to calculate the percent ozone reduction at each monitor between 1997 and 2007. The percent ozone reductions calculated for the Rhode Island monitoring locations are shown in Table 8.

Table 8
Modeled Reductions in One-Hour Ozone Levels at Rhode Island Monitoring Locations (1999-2007)

	W. Greenwich	E. Providence	Narragansett
July 8th Episode			
1999 Concentration (ppb)	139	128	106
2007 Concentration (ppb)	105	94	77
% Decrease, 1999-2007	24%	26%	27%
July 11th Episode			
1999 Concentration (ppb)	142	136	116
2007 Concentration (ppb)	124	126	122
% Decrease, 1999-2007	13%	7%	-5%

c. Predicted Ozone Design Values for 2007

The third step in this procedure was to calculate predicted 2007 ozone design values for each ozone monitoring station location. This was accomplished by reducing the 1997 ozone design values for each monitor by the percent ozone reduction predicted by the model for each episode at that location, as listed in Table 8. To assess impacts on downwind areas, the same procedure was applied to the Massachusetts, New Hampshire and Maine monitoring locations listed in Table 7.

If the calculated 2007 design value for a monitor is below the one-hour NAAQS, it is reasonable to assume that the monitor will attain the one-hour ozone NAAQS by 2007. As shown in Tables 9 and 10, the predicted 2007 design values calculated in this manner for at all Rhode Island and downwind monitoring locations, with the exception of the July 11 episode prediction for Narragansett, Rhode Island, are below the ozone NAAQS (125 ppb).

For the West Greenwich monitor, the 2007 ozone levels were 23 percent lower than those in 1999 for the July 8 episode and 12% lower for the July 11 episode. The future adjusted design values for the West Greenwich monitor, calculated using those percent reductions, were102 ppb for July 8 and 117 ppb for July 11, well below the one-hour NAAQS. For the East Providence monitor, a 26% reduction was predicted for the July 8 episode and a 7% reduction for the July 11 episode. The 1997 design value at that site, 117 ppb, was already below the standard, but would be further reduced by 2007 to 87 ppb and 108 ppb for the July 8 and July 11 episodes, respectively.

At the Narragansett monitor, the modeling of the July 8 episode predicted a 31% reduction in the ozone concentration between 1999 and 2007. This reduction would reduce the 2000 design value of 124 ppb (2000 is the first year that a design value is available for this site) to 86 ppb, well below the NAAQS. However, for the July 11 episode, the modeling predicted a disbenefit, a 5% increase in ozone levels, associated with emissions reductions. Such an increase would cause the 2007 design value to increase to 130 ppb.

Table 9
Predicted 2007 Design Values for Rhode Island and Downwind Monitors - July 8, 1988 Episode (ppb)

State	Site Name	% Reduction	1999 Design Value[8]	2007 Design Value
Rhode Island	W. Greenwich	24%	**133**	101
	E. Providence	26%	117	87
	Narragansett	27%	124[9]	90
Maine	Cape Elizabeth	7%	121	113
	Gardiner	6%	98	92
	Knox Co.	10%	119	108
	Oxford Co.	7%	79	73
	Phippsburg	8%	**125**	116
	Kennybunkport	4%	**125**	120
	Kittery	8%	**126**	117
Massachusetts	Truro	11%	**131**	117
	Fairhaven	11%	**138**	123
	Easton	10%	**125**	113
	Lawrence	7%	92	86
	Lynn	6%	113	106
	Newbury	7%	113	106
	Agawam	9%	114	103
	Chicopee	11%	**126**	112
	Amherst	11%	106	94
	Ware	10%	**132**	119
	Sudbury	8%	109	100
	Waltham	10%	108	97
	Scituate	8%	102	94
	Chelsea	7%	95	88
	Worcester	11%	108	97
New Hampshire	Laconia	4%	89	85
	Conway	0%	88	88
	Manchester	7%	103	96
	Nashua	7%	111	103
	Concord	8%	98	91
	Portsmouth	8%	117	108
	Rye	7%	**130**	121
	Rochester	9%	101	92

[8] Exceedances of the One-Hour Ozone NAAQS are bolded.
[9] Base Design Value for Narragansett is for 2000, the first year that a design value was available for that site.

Table 10
Predicted 2007 Design Values for Rhode Island and Downwind Monitors - July 11, 1987 Episode (ppb)

State	Site Name	% Reduction	1999 Design Value[10]	2007 Design Value
Rhode Island	W. Greenwich	13%	**133**	116
	E. Providence	7%	117	109
	Narragansett	-5%	124[11]	**130**
Maine	Cape Elizabeth	4%	121	116
	Gardiner	5%	98	93
	Knox Co.	8%	119	110
	Oxford Co.	5%	79	75
	Phippsburg	4%	**125**	120
	Kennybunkport	5%	**125**	119
	Kittery	6%	**126**	118
Massachusetts	Truro	16%	**131**	110
	Fairhaven	17%	**138**	115
	Easton	8%	**125**	115
	Lawrence	7%	92	86
	Lynn	5%	113	107
	Newbury	5%	113	107
	Agawam	15%	114	97
	Chicopee	13%	**126**	110
	Amherst	11%	106	94
	Ware	11%	**132**	118
	Sudbury	7%	109	101
	Waltham	6%	108	102
	Scituate	7%	102	95
	Chelsea	6%	95	90
	Worcester	14%	108	93
New Hampshire	Laconia	6%	89	84
	Conway	4%	88	85
	Manchester	10%	103	93
	Nashua	8%	111	102
	Concord	12%	98	87
	Portsmouth	6%	117	110
	Rye	6%	**130**	123
	Rochester	6%	101	95

[10] Exceedances of the One-Hour NAAQS are bolded.
[11] Base Design Value for Narragansett is for 2000, the first year that a design value was available for that site.

Because of the complicated photochemistry involved, it is possible for disbenefits to occur in some areas when emissions are reduced. In this case, however, the Narragansett monitor is too close to the boundary of the Domain for these results to be associated with a high degree of confidence. Modeling results for areas near the upwind perimeter of a domain are not considered to be as accurate as those in the rest of the Domain, because those locations are overwhelmingly affected by the boundary conditions modeled.

It should be noted that the absolute modeling for the July 11 episode predicted a 2007 one-hour concentration at Narragansett of 122 ppb, which is below the NAAQS, despite the disbenefit. Therefore, the modeled disbenefit at that location does not contradict the overwhelming evidence from this analysis that, if EPA's NOx SIP Call is fully implemented within and upwind of the New England Domain, Rhode Island will attain the one-hour ozone NAAQS by the year 2007.

d. Tier 2/Gasoline Sulfur Program Ozone Benefits

The Federal Tier 2/Gasoline Sulfur program sets more protective tailpipe emissions standards for all passenger vehicles, including sport utility vehicles (SUVs), minivans, vans and pick-up trucks, as well as lower limits for sulfur in gasoline. These new standards require passenger vehicles to be 77 to 95 percent cleaner than those on the road today and reduce the sulfur content of gasoline by up to 90 percent. The emissions reductions from this program, which will occur beginning in 2004, were not considered in the CALGRID modeling.

In 1999, EPA performed modeling runs to assess the effectiveness of the Tier 2/Gasoline Sulfur program on reducing ozone levels in both the Eastern and the Western United States. Three episodes in the summer of 1995 (a total of 36 days) were selected for that analysis because there were many exceedance days during that time period and because EPA already had model-ready meteorological input data files and OTAG runs for that time period available for comparison.

Part of EPA's modeling exercise consisted of performing two sets of modeling runs: one run with 2007 CAA emission files which included emission reductions associated with Tier 2/Gasoline Sulfur program and a second run with 2007 CAA emissions without the Tier 2/Gasoline Sulfur Program emission reductions. In both cases, the CAA emission files included EPA's NOx SIP Call emission reductions. After the modeling runs were completed, EPA used the modeling results in a relative manner to estimate the percent ozone reduction associated with the Tier 2/Gasoline Sulfur program.

The predicted ozone design values for the 2007 CAA run and the 2007 Tier 2 run are shown in Table 11 for each Rhode Island county with a monitor. The net ozone benefit associated with Tier 2 is 1 ppb for each county, or 0.8% in Kent County (the West Greenwich monitor) and 1.0% in Providence and Washington Counties (East Providence and Narragansett monitors, respectively).

Since the CALGRID 2007 runs did not account for the Tier 2/Gasoline Sulfur program, it is reasonable to conclude that the future design values at the Rhode Island monitors will be reduced by an additional 0.8 – 1.0% as a result of the Tier 2/Gasoline Sulfur program. This lends additional support to the conclusion that expected emissions reductions will be sufficient to reduce ozone levels in Rhode Island to below the one-hour NAAQS by 2007.

Table 11
Comparison of 2007 One-Hour Ozone Design Values for the CAA and the CAA + Tier 2 Emission Scenarios

County	City	Actual 1997 Design Value (ppb)	2007 CAA Design Value (ppb)	2007 Design Value – CAA & Tier 2 (ppb)	Additional Benefit from Tier 2	
					ppb	%
Kent	W. Greenwich	133	122	121	1	0.8
Providence	E. Providence	117	108	107	1	0.9
Washington	Narragansett	124[12]	103	102	1	1.0

3. 2002 Design Values

The 2002 one-hour design values for the Rhode Island monitors are:

W. Greenwich	130 ppb
East Providence	127 ppb
Narragansett	124 ppb

The highest current design value in the State, 130 ppb at West Greenwich, is thus only 4% higher than the NAAQS (125 ppb). Therefore, with a 4% reduction in ozone levels in the next five years, Rhode Island will attain the NAAQS by 2007. The evidence presented above supports the conclusion that Rhode Island ozone levels will be reduced by at least 4% by 2007 and that the State will attain the NAAQS by that date. This evidence includes the following:

- NOx emissions in the upwind states of Connecticut, New York and New Jersey will decrease by 14% between 2002 and 2007. NOx emissions in the New York City metropolitan area, which heavily impact Rhode Island ozone levels, will decrease by 11% during that time period. Similar reductions are expected in other upwind states with substantial impacts in Rhode Island.
- Although Rhode Island emissions reductions do not have as much impact on ozone levels in the State as do upwind reductions, in-state reductions do provide some further benefit in Rhode Island, as well as in downwind areas. Rhode Island's NOx emissions will be reduced by 16% between 2002 and 2007 and Rhode Island's VOC emissions will be reduced by 8% during that time period.
- The CALGRID modeling predicts a 13 – 24% decrease in the ozone concentration at the West Greenwich monitor between 1999 and 2007 as a result of implementation of the

[12] Narragansett base design value is for 2000, the first year that a design value was available for that site.

NOx SIP Call. Some of these benefits would have already occurred before 2002. However, the inventory discussed above shows that 52% of the total 1999-2007 NOx reductions in the New York City area, 63% of the 1999-2007 NOx reductions in the New York-New Jersey-Connecticut upwind area and 70% of the 1999-2007 NOx reductions in Rhode Island will occur between 2002 and 2007. Therefore, it is likely that more than half of the CALGRID-predicted 1999-2007 ozone reductions will occur in the years between 2002 and 2007. This reduction will be more than sufficient for the Rhode Island ozone design levels to be reduced by 4%. The Tier2/Gasoline Sulfur program will reduce Rhode Island ozone levels by an additional 1 ppb, or approximately 1%.

Taken together, the data and analyses present above provide strong evidence that Rhode Island will achieve attainment by 2007.

VI. Contingency Measures

Section 172(c)(9) of the CAA requires attainment demonstration SIP submittals to “provide for the implementation of specific measures to be undertaken if the area fails to …..attain the national ambient air quality standard by the attainment date applicable under this part. Such measures shall be included in the plan revision as contingency measures to take effect in any such case without further action by the State of the Administrator.” Contingency measures must reduce emissions by an additional 3% beyond the level required in the plan.

According to a 23 August 1993 EPA policy memo, contingency measures must be implemented within six months of EPA’s notification that a contingency obligation has been triggered. EPA expects that emission reductions from contingency measures will be fully realized by one year after their implementation date. Therefore, full reductions from contingency measures would need to occur within 18 months after Rhode Island’s 2007 attainment date, or during the year 2009.

As recommended by EPA Region I, RI DEM calculated the State’s contingency obligation using the adjusted 1999 emission inventory enumerated in EPA’s approval of Rhode Island’s Post-1996 Rate of Progress Plan (FR66:30814); 132.2 tpsd of VOC and 85.5 tpsd of NOx. 3% of that inventory is equal to 4.0 tpsd VOC and 2.6 tpsd NOx and the average of these values is 3.3 tpsd, which is Rhode Island’s contingency obligation.

EPA Region I used EPA’s draft non-road emission mode, core model Version 2.1d, to predict the non-road emissions reductions that will occur in Rhode Island between 2007 and 2009. The model results predicted that ozone precursor emissions from non-road engines would decrease by 1.8 tpsd during that period. RI DEM then ran EPA’s MOBILE6.2 model for 2007 and 2009, using the methodology specified in Appendix A of this document. That model predicted that on-road mobile source VOC will be reduced by 2.8 tpsd between 2007 and 2009 and that on-road mobile source emissions of NOx will be reduced by 4.2 tpsd during that period, for a total of 7.0 tpsd of on-road ozone precursor emission reductions. The input and output files for the MOBILE6.2 runs are included in Appendix B.

Therefore, the non-road and on-road emissions control measures already promulgated will be more than sufficient to meet Rhode Island’s contingency requirements should the State fail to attain the one-hour ozone NAAQS by 2007.

VII. Mobile Source Emission Budget

A. Background

Transportation conformity is required by section 176(c) of the CAA. EPA's transportation conformity rule requires that transportation plans, programs and projects conform to SIPs. Conformity to a SIP means that transportation activities will not produce new air quality violations, worsen existing violations, or delay timely attainment of National Ambient Air Quality Standards. States are required to establish on-road mobile source emissions budgets in attainment demonstration SIPs. Transportation plans, programs and projects are required to meet the on-road mobile source emissions budget, thus assuring conformity with the SIP.

B. 2007 Conformity Budget for Rhode Island

Rhode Island is establishing a new conformity budget for VOC and NOx for Rhode Island for 2007, the attainment year. This 2007 transportation conformity budget, when approved by the EPA, will replace the 1999 budget in Rhode Island's ROP. The 1999 budget was calculated using EPA's on-road mobile source emissions factor model, MOBILE5, while the 2007 budget is calculated using the updated version, MOBILE6.2. A description of the process used and assumptions made in developing the MOBILE6.2 input files is included in Appendix A of this document. The actual input and output files are included in Appendix B.

The methodology used to determine mobile source emissions estimates for Rhode Island was agreed to by staff at the Rhode Island Statewide Planning Program, RI DEM, the Rhode Island Department of Transportation (RIDOT) and US EPA Region I. These estimates form the basis for the Rhode Island Mobile Source Emissions Budget shown in Table 12 below. A summary of the methodology used to derive the budget is included in Appendix A. Note that the mobile source emissions budget does not include refueling losses.

Table 12
Rhode Island Mobile Source Emissions Budget

Pollutant	2007 Emissions Budget (tpsd)
Volatile Organic Compounds (VOC)	30.37
Nitrogen Oxides (NOx)	33.62

VIII. Reasonably Available Control Measures Analysis (RACM)

A. Summary

Section 172(c)(1) of the CAA requires that attainment SIPs contain all Reasonably Available Control Measures (RACM) necessary to allow attainment as expeditiously as practicable. Rhode Island has analyzed the availability of RACM for ozone precursor emissions sources in the State. That analysis, which is presented below, leads to the conclusion that there are no additional measures that could be implemented in the State that would enable Rhode Island to attain the one-hour ozone NAAQS earlier than 2007.

B. EPA Guidance

EPA's guidance for interpreting the RACM requirements of section 172(c)(1) of the CAA states that only potentially available measures that would advance the attainment date for an area should be considered RACM and that states may consider local conditions, such as economics or implementation concerns, in rejecting potential control measures. Below are excerpts from relevant EPA documents that interpret the RACM requirement.

- *Federal Register/Vol. 44, No. 66/April 4, 1979/General Preamble for Proposed Rulemaking*.
  "Part D requires the SIP to provide for the level of control necessary to assure attainment of the standards as expeditiously as practicable, and no later than the specified deadlines, and reasonable further progress in the interim. It does not require that all sources apply RACM if less than all RACM will suffice for reasonable further progress and attainment."

- *EPA Memorandum, "Additional Submission on RACM From States With Severe 1-hour Ozone Nonattainment Area SIPs", from John S. Seitz, EPA Director office of Air Quality Planning and Standards and Marge Oge, EPA Director Office of Transportation and Air Quality to Regional Air Division Directors, Regions I, II, III, V and VI, December 14, 2000.* "…for purposes of the attainment demonstration SIPs, measures could be justified as not meeting RACM if a measure (a) is not technically or economically feasible, or (b) does not advance the attainment date for the area."

Based on this EPA guidance, potential control measures evaluated in this analysis were not considered RACM unless they met the following criteria:

1. Implementation of the control measure would accelerate attainment in Rhode Island; and

2. The control measure is both economically and technically feasible.

C. Impact of Emissions Reductions

As discussed above, the trajectory analyses, the CAM-x analysis and the CALGRID modeling demonstrate that elevated one-hour ozone concentrations in Rhode Island are largely the result of the transport of pollutants into the State from upwind high emission areas. In fact, the CAM-x source apportionment modeling showed that emissions in Connecticut and Rhode Island combined contribute only 5% to the anthropogenic one-hour ozone levels in the State. Therefore, the above analyses clearly demonstrate that Rhode Island cannot attain the one-hour NAAQS without substantial NOx emission reductions in upwind states, and that, since upwind controls will not be fully implemented prior to 2007, the adoption of additional in-state emission reduction measures would not advance the State's attainment date. Nevertheless, for completeness sake, RI DEM has examined Rhode Island's projected 2007 emissions inventory in an attempt to identify any technically and economically feasible additional controls that may substantially reduce ozone precursor emissions in the State.

D. Stationary Point, Stationary Area and Non-Road Mobile Sources

1. VOC Emissions from Stationary Point, Stationary Area and Non-Road Mobile Sources

To identify stationary point source categories that will emit a substantial amount of VOC in 2007, RI DEM sorted the processes associated with point source emissions by SCC code and summed emissions for all sources in the same 6-digit SCC code. Table 13 lists the emissions for all point source categories which emit at least 0.01 tpsd VOC. A similar procedure was used to calculate VOC emissions for source categories in the stationary area and non-road mobile sectors. (See Tables 14 and 15, respectively).

Table 16 lists the VOC emissions for the sixteen point, area and non-road mobile source categories that emit at least 0.88 tpsd VOC, 1% of the total VOC emissions for these three sectors. These sixteen source categories together account for 77.97 tpsd of VOC, 89% of the total VOC emissions from these sectors, and include eight area source categories emitting a total of 52.92 tpsd VOC, four non-road mobile source categories emitting a total of 19.17 tpsd and four point source categories emitting 5.87 tpsd.

RI DEM then examined these source categories to attempt to identify additional RACM measures. That analysis follows.

a. Stationary Area Sources -VOC

The eight stationary area source categories identified account for 52.92 tpsd VOC emissions, or 60% of the total 2007 VOC emissions from the stationary point, stationary area and non-road mobile source sectors. Sources in this sector include the three largest emission source categories identified; small surface cleaning, small surface coating and commercial and consumer solvents; which together emit 36.54 tpsd VOC.

Most of the sources in the small surface cleaning sector, including all vapor degreasers and cold cleaners, are regulated by RI Air Pollution Control (APC) Regulation No. 36, “Control of Emissions from Organic Solvent Cleaning,” which became effective in 1996. This regulation incorporates control requirements from EPA’s Control Technique Guideline (CTG) for this source category, as well as the requirements of EPA’s 1994 National Emission Standard for Hazardous Air Pollutants (NESHAP) for Halogenated Solvent Cleaners. These requirements represent Reasonably Available Control Technology (RACT). RI DEM has agreed to analyze the OTC model rule for solvent cleaning to adopt any appropriate measures in the model rule that are not currently included in Regulation No. 36. It is clear, however, that any such additional measures would result in relatively small decreases in emissions from this source category. A 2001 report by Pechan Associates commissioned by the OTC[13] estimated that adoption of the OTC provisions for this source category would reduce emissions by 5 tpsd. The actual benefits of adoption of these measures may actually be lower than this estimate, because the Rhode Island rule is currently more stringent than the Federal rule. VOC reductions of this magnitude would not accelerate the State’s attainment of the one-hour ozone NAAQS, but may help the State attain the eight-hour ozone NAAQS in the future.

Similarly, surface coaters that emit at least 15 pounds of VOC in any day from paper, fabric, vinyl, metal parts and products, magnet wire, coil, flat wood paneling, metal furniture and large appliance coating operations are regulated by RI APC Regulation No. 19, “Control of Volatile Organic Compounds from Surface Coating Operations.” This regulation, which was last updated in 1996, represents RACT, and thus, would be considered consistent with RACM. Surface coaters not covered by this regulation are very small businesses, and regulation of those sources is not economically feasible at this time.

A 1998 EPA regulation limits the VOC contents of consumer and commercial products nationally. RI DEM has agreed to adopt the more stringent limitations included in the OTC model rule for this source category. The Pechan report estimates that adoption of this rule will result in a 1 tpsd VOC emissions reduction for 2007, an amount that would not accelerate the State’s attainment of the one-hour NAAQS; however, it is hoped that such measures will aid the State in moving towards attainment of the eight-hour ozone NAAQS.

The five other area source categories identified in Table 16 as having substantial VOC emissions in 2007 are architectural coatings (including traffic paints), gasoline distribution, graphic arts, landfills and automobile refinishing. Like commercial and consumer solvents, the VOC content of architectural coatings is currently limited by Federal regulation. RI DEM has agreed to adopt the more stringent OTC recommended limitations for that source category, which, according to the estimates in the Pechan report, would reduce VOC emissions in the State by 3 tpsd in 2007. Implementation of those more stringent limitations will not accelerate attainment, but may aid in attaining the eight-hour NAAQS.

Gasoline distribution activities are regulated in the State by APC Regulation No. 11, “Petroleum Liquids Marketing and Storage,” which was last updated in 2001. In addition to requirements applicable to point sources, Regulation No. 11 includes standards for Stage I and Stage II vapor controls at gasoline refueling

---

13 E.H. Pechan & Associates, Inc., Control Measure Development Support Analysis of Ozone Transport Commission Model Rules, Pechan Report No. 01.02.001/9408.000. March 31, 2001.

stations and tank truck certification and vapor collection systems. Additional controls on this source category would result in minimal additional emissions reductions and would not accelerate attainment. Note that RI DEM is planning to adopt OTC's requirements for portable fuel containers, which would result in an estimated VOC emissions reduction of 1 tpsd, an amount that would not accelerate attainment of the one-hour NAAQS.

Small graphic arts sources are generally not regulated in the State, except when the operations at a facility are consistent with the surface coating definitions in APC Regulation No. 19. However, emissions from this source category, which is comprised of small businesses, total less than 3 tpsd. Any control requirements for those facilities would yield small reductions in VOC emissions and would not accelerate attainment of the one-hour ozone NAAQS. Note that larger graphic arts facilities are regulated by RI APC Regulation No. 21, "Control of Volatile Organic Compound Emissions from Printing Operations," which was last amended in 1996.

The area source landfill emissions in the State are generated by several small, closed landfill facilities. Landfill gas emissions from the Rhode Island Resource Recovery's Central Landfill, an active point source landfill in Johnston, Rhode Island, are captured by an extensive vapor collection system and controlled by a series of flares and engines. However, emissions from the area source landfills are too low for installation of such systems to be economically feasible. Automobile refinishing operations in the State are regulated by APC Regulation No. 30, "Control of Volatile Organic Compounds from Automobile Refinishing Operations," which was last amended in 1996. RI DEM has agreed to analyze the OTC model rule for this source category and to adopt any indicated additional measures into Regulation No. 30. The Pechan report estimated that adoption of the OTC measures would reduce emissions from this source category by 1 tpsd. This amount may be overestimated, because this source category is already regulated in Rhode Island. Clearly, adoption of additional requirements would not sufficiently reduce the 1.53 tpsd VOC emissions from this category to accelerate attainment of the one-hour NAAQS.

In summary, RI DEM did not identify any additional area source RACM measures.

b. Non-road Mobile Sources –VOC

Four non-road mobile source categories were identified in Table 16; 4-stroke non-road engines, which emit 7.21 tpsd VOC, 2-stroke pleasure craft emitting 6.78 tpsd, 2-stroke non-road engines emitting 3.34 tpsd and diesel engines, which emit 1.84 tpsd. All of these source categories are subject to EPA non-road regulations.

Lawn and garden equipment, such as lawn mowers, turf equipment, lawn and garden tractors and rotor tillers and commercial equipment, including generators, pumps and pressure washers, are responsible for 5.44 and 1.31 tpsd, respectively, of the 7.21 tpsd emitted from 4-stroke non-road engines. In July 1995, EPA issued Phase I emissions standards applicable to these types of small spark-ignition engines beginning with model year 1997. More stringent Phase 2 standards were issued in March 1999 for non-handheld equipment in this category and will be phased-in between 2001 and 2007. Phase 2 standards for handheld equipment, to be phased-in between 2002 and 2007, were issued in March 2000. 2-stroke non-road engine VOC emissions, which are from lawn and garden equipment in Rhode Island, are also covered by those standards.

EPA emissions standards for pleasure craft were issued in October 1996, covering model year 1998 and later. EPA proposed more stringent standards for this source category in July 2002.

Rhode Island's VOC non-road diesel engine emissions are primarily associated with construction equipment, such as tractors, backhoes, excavators and cranes, and with industrial material-handling equipment. Standards for those engines were published in 1994. Tier 1 standards apply to model year 1996– 2000 equipment, more stringent Tier 2 standards to model years 2001- 2006, and still more stringent Tier 3 standards to post-2006 equipment.

Since all of the non-road source categories are subject to EPA requirements, no additional RACM emissions standards for these source categories were identified. Some areas have instituted programs, such as buy-back or equipment exchange programs, to attempt to accelerate the retirement of older model, higher emitting equipment. However, those programs requires an outlay of funds not available at this time in Rhode Island, and thus implementation of such programs is not be economically feasible in the State.

It should be noted that the ozone alerts issued by RI DEM on days that elevated ozone levels are predicted contain, in addition to public health information, recommendations for reducing emissions during high ozone periods. The alerts recommend that pollutant- emitting activities, like driving, refueling and mowing lawns, be limited or postponed during high ozone periods. The effectiveness of those recommendations on reducing the use of lawn and garden equipment on high ozone days has not been quantified.

c. Stationary Point Sources – VOC

Due to institution of point source control programs, 2007 point source emissions constitute only 10% of total VOC emissions in Rhode Island. Table 16 list four point source categories; bulk terminals, with 1.82 tpsd VOC emissions, fabric coating and printing, with 1.51 tpsd, drum cleaning and reclamation, 1.42 tpsd and paper coating, 1.13 tpsd. These source categories are already subject to recently updated RI DEM regulations – bulk terminals are regulated by APC Regulation No. 11 and the other three categories by APC Regulation No. 19. Note that the all of the drum cleaning and reclamation emissions come from one facility. Since the drum cleaning and reconditioning processes at that facility utilize aqueous based caustic cleaners and shot blast operations rather than solvents, VOC emissions from that facility are associated with surface coating the reconditioned drums, a process covered by Regulation No. 19 and which will be covered in the future by NESHAP requirements.

Since applicable VOC point sources are already covered by RACT requirements in existing regulations, no RACM could be identified for this sector.

Table 13 2007 VOC Emissions from Point Source Categories

6-Digit SCC	Process Description	Emissions (tpsd)
404001	Bulk Terminals	1.82
402011	Fabric Coating/Printing	1.51
309025	Drum Cleaning/Reclamation	1.42
402013	Paper Coating	1.13
402022	Plastic Parts Coating	0.73
301009	Cleaning Chemicals	0.61
314015	Boat Manufacturing	0.45
501004	Landfill Dump	0.43
402021	Flatwood Coating	0.37
308010	Plastic Products Manufacturing	0.37
402025	Miscellaneous Metal Parts	0.34
402026	Steel Drums	0.32
402007	Surface Coating Application -	0.30
399999	Miscellaneous Industrial Processes	0.26
402019	Wood Furniture Surface Coating	0.22
308006	Other Fabricated Plastics	0.18
402001	Surface Coating Application -	0.14
502005	Incineration: Special Purpose	0.13
309030	Fabricated Metals	0.11
501007	Sewage Treatment (POTW)	0.11
201002	Nat. Gas EGU Turbine	0.10
405004	Lithographic Printing	0.09
305014	Glass Manufacture	0.09
301018	Plastics Production	0.08
401888	Solvent Fugitive Emissions	0.08
301121	Organic Dye/Pigment Manufacture	0.07
402012	Fabric Dyeing	0.06
401003	Cold Cleaning	0.06
302003	Bakery	0.06
401001	Dry Cleaning	0.06
401002	Vapor Degreasing	0.05
301026	Synthetic Rubber Manufacture	0.05
315020	Laboratory	0.04
203008	Landfill Gas Turbine	0.04
101005	EGU - Distillate Oil	0.04
203002	Comm/Indus Recip. Engine - Nat Gas	0.03
305002	Asphalt Plant	0.03
301820	Indus. Waste Water Treatment	0.03
103004	Comm/Indus Boiler - Residual Oil	0.03
315031	Medical Laboratory	0.03
288888	Misc. Fugitive - Internal Combustion	0.02
403888	Fugitive - Petroleum Prod. Storage	0.02
203001	Comm/Inst Turbine - Distillate Oil	0.02
202003	Indus. Recip. Engine - Gasoline	0.01
201001	EGU turbine - Distillate Oil	0.01
306009	Petroleum Indus - Flares	0.01
103006	Comm/Ins Boiler - Nat Gas	0.01
504104	Air Stripping	0.01
102006	Industrial Boiler - Nat. Gas	0.01
406004	Motor Vehicle Refueling	0.01
202004	Large Diesel Engine	0.01
102004	Industrial Boiler - Resid. Oil	0.01

Table 14
2007 VOC Emissions from Area Source Categories

6-Digit SCC	Process Description	Emissions (tpsd)
241500	Surface Cleaning	12.44
24010	Small Surface Coating	12.06
246000	Commercial & Cons. Prod.	12.04
240100	Arch. Coatings/Traffic Paints	5.43
250106	Gasoline Distribution[14]	4.32
242500	Graphic Arts	2.98
262000	Landfills	2.12
402016	Auto Refinishing	1.53
246180	Pesticide Application	0.51
281003	Fires	0.23
266000	Leaking USTs	0.15
210300	Small Source Combustion	0.14
490002	Oil Spill	0.12
501007	POTWs	0.07
242000	Drycleaning	0.06
264000	TSDFs	0.01
246102	Cutback/Emulsified Asphalt	0.00

Table 15
2007 VOC Emissions from Non-road Mobile Source Categories

6-Digit SCC	Process Description	Emissions (tpsd)
226500	4- Stroke Non-road Engines	7.21
228200	2- Stroke Pleasure Craft	6.78
226000	2- Stroke Non-road Engines	3.34
227000	Diesel Engines	1.84
228201	4- Stroke Pleasure Craft	0.74
227500	Aircraft	0.38
228000	Commercial Marine Vessels	0.23
228202	Diesel Pleasure Craft	0.08
228500	Locomotive Engines	0.02

[14] Area source gasoline distribution emissions due not include Stage II refueling emissions, which are included in the non-road mobile source sector.

Table 16
2007 VOC Emissions from Substantial Stationary Area,
Stationary Point and Non-road Mobile Source Categories

6-Digit SCC	Sector	Process Description	Emissions (tpsd)
241500	Area	Surface Cleaning	12.44
24010	Area	Small Surface Coating	12.06
246000	Area	Commercial & Cons. Prod.	12.04
226500	Non-road	4 Stroke Non-road Engines	7.21
228200	Non-road	2 Stroke Pleasure Craft	6.78
240100	Area	Arch. Coatings/Traffic Paints	5.43
250106	Area	Gasoline Distribution	4.32
226000	Non-road	2 Stroke Non-road Engines	3.34
242500	Area	Graphic Arts	2.98
262000	Area	Landfills	2.12
227000	Non-road	Diesel Engines	1.84
404001	Point	Bulk Terminals	1.82
402016	Area	Auto Refinishing	1.53
402011	Point	Fabric Coating/Printing	1.51
309025	Point	Drum Cleaning/Reclamation	1.42
402013	Point	Paper Coating	1.13

2. NOx Emissions from Stationary Point, Stationary Area and Non-Road Mobile Sources

To identify stationary point, stationary area and non-road mobile source categories that will still have substantial NOx emissions in 2007, RI DEM sorted processes by SCC code and summed emissions for all sources in the same 6-digit SCC code. Table 17 lists the emissions for NOx point source categories, while stationary area and non-road mobile sector source category emissions are listed in Tables 18 and 19, respectively.

Table 20 lists the NOx emissions for the fourteen point, area and non-road mobile source categories that emit at least 0.40 tpsd, 1% of the total NOx emissions for these three sectors. These fourteen source categories together emit 37.06 tpsd of NOx, or 93% of the total NOx emissions from these sectors and include seven non-road mobile source categories emitting a total of 28.85 tpsd NOx, six point source categories emitting a total of 6.92 tpsd and one area source category emitting 1.29 tpsd.

RI DEM examined those source categories to attempt to identify additional RACM measures. That analysis follows.

a. Non-road Mobile Sources - NOx

Non-road mobile source NOx emissions dwarf those of the stationary source sectors. Diesel non-road engines alone emit 18.47 tpsd NOx, approximately half of the total NOx emissions from the fourteen source categories listed in Table 20.

Diesel non-road NOx emissions in Rhode Island are associated primarily with construction equipment, including tractors, loaders, backhoes, bulldozers and excavators. Industrial equipment, such as air conditioning and refrigeration units and forklifts, commercial lawn and garden equipment, such as turf equipment and commercial equipment, such as generators and air compressors, also contribute to diesel NOx emissions. As discussed above, in 1996 the EPA promulgated emissions standards for diesel engines. Tier 1 of these standards apply to model years 1996 – 2000, Tier 2 to 2001 – 2006 and Tier 3 to post-2006 model years.

Liquid propane gas (LPG) non-road engines, primarily forklifts, emit 4.42 tpsd NOx. EPA standards for those engines were promulgated in September 2002 and are effective for model year 2004 – 2006 (Tier 1 standards) and model year 2007 and beyond (Tier 2 standards).

4-stroke engines emit 1.64 tpsd NOx, primarily from lawn and garden equipment and commercial generators. As discussed above, a 1995 EPA rule required sources in this category to comply with Phase 1 emissions standards beginning with model year 1997. Phase 2 standards for non-handheld equipment were promulgated in 1999 and will be phased-in between 2001 and 2007, and Phase 2 standards for handheld equipment were promulgate in 2000, to be phased-in between 2002 and 2007.

Commercial marine vessels emit 2.30 tpsd NOx. Standards for this source category were promulgated in April 2002 and are effective for model years 2004 -2006 (Tier 1) and 2007 and later (Tier 2). EPA regulations also limit NOx and CO emissions from commercial aircraft with thrusts greater than 26.7 kiloNewtons which were certified or manufactured after April 1997. Aircraft contribute 0.95 tpsd NOx to Rhode Island's 2007 emissions inventory.

Diesel pleasure craft emit 0.58 tpsd NOx and railroad equipment and locomotives 0.49 tpsd NOx. A September 2002 EPA regulation limits emissions from diesel pleasure craft, effective between 2006 and 2009, depending on engine size. 90% of Rhode Island's railroad emissions are associated with locomotives; 1999 EPA regulations set remanufacture, maintenance and testing requirements for all locomotives manufactured after 1972.

Since non-road NOx emitting sources are already subject to recent EPA emissions limitations, RI DEM did not identify any additional RACM measures for this sector.

b. Stationary Point and Area Sources-NOx

All of the stationary point and area source NOx-emitting categories listed in Table 20 are combustion sources. EPA's NOx SIP Call examined NOx-emitting combustion point sources, including electric generating units (EGU) and non-EGU boilers, internal combustion engines, process heaters, and cement kilns. Due to concerns about costs and feasibility, EPA limited the NOx SIP Call to large point sources. RI DEM adopted EPA's NOx SIP Call budget for Rhode Island in 1999 in APC Regulation No. 41, "NOx Budget Trading Program."

Rhode Island's NOx point sources are also subject to the NOx RACT requirements in RI APC Regulation No. 27, "Control of Nitrogen Oxide Emission," which was last amended in 1996. Area sources, like residential and commercial boilers, are too numerous and too small to be feasibly controlled. Therefore, it is reasonable to conclude that there are no additional RACM available for this source category.
\
In conclusion, no RACM were identified for NOx or VOC emissions from non-road mobile or stationary point and sources.

Table 17
2007 NOx Emissions from Point Source Categories

6-Digit SCC	Process Description	Emissions (tpsd)
201002	Electric Generating Unit (EGU) – Natural Gas	2.28
103004	Commercial/Institutional Boilers – Residual Oil	1.42
102004	Industrial Boilers – Residual Oil	1.06
305014	Glass Furnace	0.98
101005	EGU - Distillate Oil	0.77
103006	Commercial/Institutional Boilers – Natural Gas	0.40
502005	Sewage Sludge Incinerators	0.38
201001	EGU - Distillate Oil	0.36
202004	Industrial Large Bore Engine	0.28
308006	Plastics Manufacture Process Fuel	0.22
390006	Industrial Process Fuel – Natural Gas	0.17
203008	Landfill Gas Combustion	0.16
102006	Industrial Boilers - Natural Gas	0.14
203002	Commercial/Institutional Boilers – Natural Gas	0.14
203001	Commercial/Institutional IC Boiler – Distillate Oil	0.12
202001	Industrial IC Boiler – Distillate Oil	0.02
501004	Landfill Gas Engine	0.02
201900	EGU – Flares	0.01
103005	Commercial/Institutional EC Boiler – Distillate Oil	0.01
305002	Asphalt Plant	0.007
102005	Industrial EC Boiler – Distillate Oil	0.003
202003	Industrial Internal Combustion Boiler – Gasoline	0.0006

Table 18
2007 NOx Emissions from Area Source Categories

SCC	Process Description	Emissions (tpsd)
21030040	Small Source Combustion	1.29
28100300	Fires	0.03

Table 19
2007 NOx Emissions from Non-road Source Categories

6-Digit SCC	Process Description	Emissions (tpsd)
227000	Diesel Non-road Engines	18.47
226700	LPG Non-road Engines	4.42
228000	Commercial Marine Vessels	2.30
226500	4-Stroke Non-Road Engines	1.64
227500	Aircraft	0.95
228202	Diesel Pleasure Craft	0.58
228500	Railroad Equipment & Locomotives	0.49
226800	CNG Non-Road Engines	0.37
228201	4-Stroke Pleasure Craft	0.24
228200	2-Stroke Pleasure Craft	0.18

Table 20
2007 NOx Emissions from Substantial Stationary Area,
Stationary Point and Non-road Mobile Source Categories

6-Digit SCC	Sector	Process Description	Emissions (tpsd)
227000	Non-Road	Diesel Non-road Engines	18.47
226700	Non-Road	LPG Non-road Engines	4.42
228000	Non-Road	Commercial Marine Vessels	2.30
201002	Point	EGU - Natural Gas	2.28
226500	Non-Road	4-Stroke Non-Road Engines	1.64
103004	Point	Commercial/Institutional Boilers - Residual Oil	1.42
210300	Area	Small Source Combustion	1.29
102004	Point	Industrial Boilers – Residual Oil	1.06
305014	Point	Glass Furnace	0.98
227500	Non-Road	Aircraft	0.95
101005	Point	EGU - Distillate Oil	0.77
228202	Non-Road	Diesel Pleasure Craft	0.58
228500	Non-Road	Railroad Equipment & Locomotives	0.49
103006	Point	Commercial/Institutional Boilers – Natural Gas	0.40

E. On-Road Mobile Sources

This section provides an analysis of the availability of RACM for on-road mobile sources of ozone precursor emissions. On-road mobile sources are a significant source of NOx and VOC emissions in Rhode Island; 33.6 tpsd NOx (46% of total) and 31.0 tpsd VOC (26% of total) will be emitted in the State from mobile sources in 2007.

It should be noted, however, that, despite a projected substantial increase in the number of vehicle miles traveled in Rhode Island, 2007 on-road mobile source NOx emissions will be 12.7 tpsd, or 36% lower than in 1999, and will be 18.5 tpsd, or 27%, lower than in 2002. Similarly, on-road VOC emissions will be 21.3 tpsd, or 41%, lower in 2007 than in 1999, and will decrease by 8.3 tpsd, or 21%, between 2002 and 2007. Those decreases are the result of the implementation of Federal Tier II tailpipe controls, the National Low Emissions Vehicle program, Phase II Reformulate Gasoline, the Heavy Duty Diesel Standard, and State Enhanced Motor Vehicle Inspection/Maintenance requirements.

In addition to the above programs, RI DEM, in conjunction with the State Planning Council, the Office of Statewide Planning, and the RI Department of Transportation (RI DOT) and others, works on the design of the State's Congestion Mitigation and Air Quality (CMAQ) program. CMAQ projects reduce ozone precursor emissions in the transportation sector.

Table 21 lists the CMAQ programs which are included in Rhode Island's 2003-2004 Transportation Implementation Plan (TIP), along with the expected emissions reductions associated with those programs. These programs include measures aimed at increasing bicycle, ferry and public transit travel, eliminating traffic congestion through improving transportation management, signalization and roadways, and reducing emissions from diesel on-road vehicles with a heavy duty vehicle inspection program and the installation of emissions controls on public transit diesel busses. Together, these programs are expected to reduce VOC emissions in the State by 148.6 kilograms (kg), or 0.16 tons, per summer day, and to reduce NOx emissions by 131.9 kg, or 0.15 tons, per summer day.

Implementation of these projects and other similar programs that will be funded with CMAQ monies in the coming years will not result in an acceleration of the attainment date. However, it is important that such projects continue to be funded, because, at the current growth rate, the increase in vehicles mile traveled in the State will eventually outstrip efforts to reduce emissions from cars with stricter inspections, cleaner engines and cleaner fuels.

Since a large number of mobile source emissions control programs are already being implemented and since additional measures funded by CMAQ monies would not accelerate the attainment date, RI DEM did not identify any additional mobile source RACM measures.

Table 21
CMAQ Programs in Rhode Island's Current
Transportation Implementation Plan

Project Name	Sponsor	VOC Reductions (kg/day)	NOx Reductions (kg/day)
Barrington Bike/Pedestrian Connector- County/Mathewson Rd	Barrington	1.0	1.6
Heavy Duty Vehicle Inspection	RI DEM	0.13	NA
Bike Guide	RI DOT	3.2	5.1
Bike/Pedestrian Program	RI DOT	5.5	8.7
Traffic Management Center	RI DOT	38.4	-4.8
Arterials Program	RI DOT	5.9	-0.7
Coordinated Signalization	Newport	1.4	-0.2
Bike to Work/College	Providence Foundation	5.8	7.5
Express Travel	RIPTA	25.5	40.4
Seasonal Ferry Service	RIPTA	17.4	28.0
Posted Intermodal Info Program/TF Green	RIPTA	NA	NA
Service Initiatives	RIPTA	1.6	1.7
Transit Hubs/Paratransit	RIPTA	NA	NA
High Efficiency Diesel Bus Emission Control	RIPTA	30.2	0
Ozone Alert Days	RIPTA	12.2	19.4
State CNG Infrastructure	State Energy Office	0.4	25.2
TOTAL		148.6	131.9

F. Co-Benefits of Greenhouse Gas Controls

In the fall of 2001, RI DEM and the RI State Energy Office convened a group of over 30 diverse stakeholders from business, industry, citizen groups, environmental organizations, and other government agencies to develop a Greenhouse Gas Action Plan for Rhode Island. The convening of this group was largely precipitated by concerns about the global warming caused by emissions of carbon dioxide and other greenhouse gases and the effect of this phenomenon on Rhode Island's environment and economy. The Rhode Island process built on a recent agreement signed by all of the New England Governors and Eastern Canadian Premiers to reduce greenhouse gases in the region to 1990 levels by 2010, 10% below those levels in 2020, and by as much as 75% over the longer-term.

In the Rhode Island Greenhouse Gas Action Plan published in July 2002, the stakeholder group listed 52 program and policy options designed to reduce greenhouse gas emissions in Rhode Island. Forty-nine of the options are consensus options endorsed by all the stakeholders. Also, 49 of the options are primarily in-state options, while only three options would require regional or national implementation. Of the full set of options, 25 are targeted at buildings and facilities, 11 at transportation, 6 at land use, 6 at energy supply, and 4 at solid waste. In addition to these 52 options, the Stakeholders also identified numerous other potentially fruitful areas for Rhode Island to track and study for possible future inclusion in the Plan.

The options identified, along with the projected carbon equivalent greenhouse gas reductions associated with those options, are listed in Table 22. The group now is proceeding with the second phase of this process, which involves further research and analysis of and design of implementation strategies for the key high priority program and policy options. In Phase III of the process, the group plans to implement the highest priority options and to develop implementation plans for the other options. These projects are generally outside of the RI DEM's regulatory authority.

Although this plan was designed to reduce emissions of greenhouse gases, these options, if implemented, could result in co-reductions in emissions of the ozone precursors NOx and VOC. The projected co-benefits calculated by the stakeholder group are presented in Figure 34. Although these programs will not hasten attainment of the one-hour ozone NAAQS in the State, if implemented, they may help Rhode Island to attain the eight-hour standard in the future.

Table 22 Greenhouse Gas Reduction Options in Rhode Island Plan

#	Name	Saved Carbon[15]	#	Name	Saved Carbon
	Higher Priority Consensus In-State Options			***Lower Priority Consensus In-State Options***	
	Buildings and Facilities			**Buildings and Facilities**	
1	Commercial/Industrial Fossil Fuel Retrofit	100	30	Compact Floorspace Initiative	5
2	Compact Residential Appliances Initiative	80	31	Switch from Electric to Fossil Fuel Heating	1
3	Energy Efficiency Targeting Initiative (Indus)	40	32	Solar Photovoltaic (PV) Buydown Program	1
4	Combined Heat & Power Initiative (Industrial)	35	33	Active Solar Hot Water Heating Initiative	1
5	Electric Energy Efficiency Retrofit in Non-Residential Buildings and Facilities	30	34	Non-Residential Natural Gas Air Conditioning Initiative	<1
6	Efficient Residential Fossil Fuel Heating	25		**Transportation**	
7	Tax Credits For Energy Efficiency	15	35	Fleet Fuel GHG Content Mandate	40
8	Combined Heat & Power Initiative (Non-indus)	15		**Land Use**	
9	Efficient Residential Electric Cooling	10	36	Conversion of Marginal Cropland to Forest Initiative	40
10	Retrofit Program For Electrically Heated Residences	9	37	Conversion of Marginal Cropland to Wetlands Initiative	<1.5
11	Retrofit For Fossil Heated Residences	6	38	Low Input Agriculture &Improvd Cropping Sys Init	0.4
12	Electric Equipment Retrofit Program (Small Commercial & Industrial)	5	39	Forest Management Initiative	TBD
13	Public Facilities Efficiency Initiative	5		**Energy Supply**	
14	Efficient Residential Lighting/Appliances	5	40	Promote New Renewable Electricity Supply Using System Benefit Charge Funds	8
15	Efficient Non-Residential Construction	5	41	Promote Green Power Purchases Using System Benefit Charge Funds	13
16	Energy Star Home Construction Program	1	42	Incentive Package Initiative	
				• Production tax credit	2
				• Investment tax credit	2
				• Net metering	0.2
				• Backup rates	TBD
17	Use of Lower Carbon Fossil Fuels	TBD[16]	43	Direct government Investments or Expenditures in Renewable Energy	0.5
	Transportation			**Solid Waste**	
18	Local Fuel Economy Improvements (Feebate)	125	44	Deposit Bottle System (“Bottle Bill”)	19
19	Transit Oriented Development and Enhancing Transit Options and Operations	19		***Non-Consensus In-State Options***	
20	Expand Bicycle/Pedestrian Infrastructures	19		**Buildings and Facilities**	
21	Commuting Efficiency Program	19	45	Upgrade New Residential Construction Building Code	20
22	Commuting Trip Reduction Initiative	18	46	Upgrade New Commercial Construction Building Code	40
23	Government Owned And Private Fleet	<2.5		**Transportation and Land Use**	
	Land Use		47	Increase the Gasoline Tax	38
24	Urban/Suburban Forestry Program	<120		***Consensus Regional/National Options***	
25	Open Space Protection Program	60		**Buildings and Facilities**	
	Energy Supply/Solid Waste		48	Upgrade And Extend Appliance Efficiency Standards	100
26	Renewable Portfolio Standards	140		**Transportation**	
27	Resource Management (RM) Contracting	70	49	National Fuel Efficiency Standards For Cars And Light Trucks (CAFÉ)	250
28	Pay-As-You-Throw (PAYT) Initiative	55		**Energy Supply**	
29	State Facilities Renewable Purchase Req.	0.4	50	Carbon (And Multi-Pollutant) Cap And Permit Trade System For the Power Sector	140

[15] Estimates of thousands of metric tons in 2020 of greenhouse gases expressed as carbon equivalent
[16] TBD: To Be Determined

G. Overall RACM Conclusions

A number of emissions controls programs have been implemented in Rhode Island since the Clean Air Act Amendments of 1990, and substantial further emissions reductions will occur in the State and in upwind areas by 2007. RI DEM intends to continue to continue to investigate and, where appropriate, adopt additional measures that would reduce emissions of ozone precursors even further. Such measures may help the State in the future, as it moves towards attainment of the eight-hour ozone NAAQS. However, attainment of the one-hour NAAQS in the State is overwhelmingly dependent on upwind emissions reductions that will not be fully implemented until 2007. Further, the source categories emitting the vast preponderance of ozone precursor emissions in the State are already subject to control requirements. Therefore, there are no additional technologically and economically feasible control measures that would result in Rhode Island attaining the one-hour ozone NAAQS earlier than 2007, and Rhode Island has adopted all RACM measures.

Figures

Figure 1

New England Modeling Domain

SW Corner UTM Coordinates (Zone 19) 4570000 N, 120000 E
NE Corner UTM Coordinates (Zone 19) 4910000 N, 460000 E

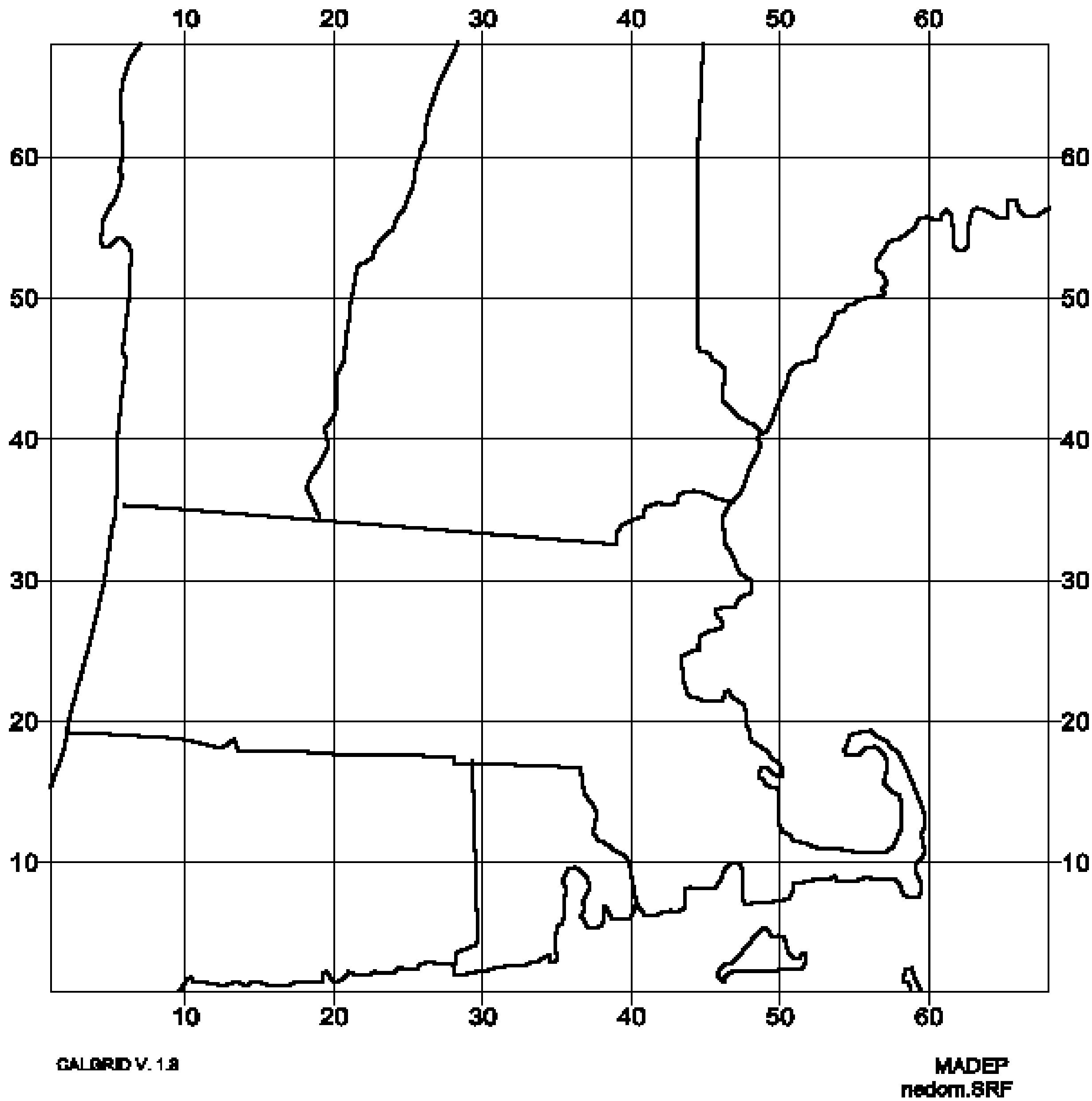


Figure 2

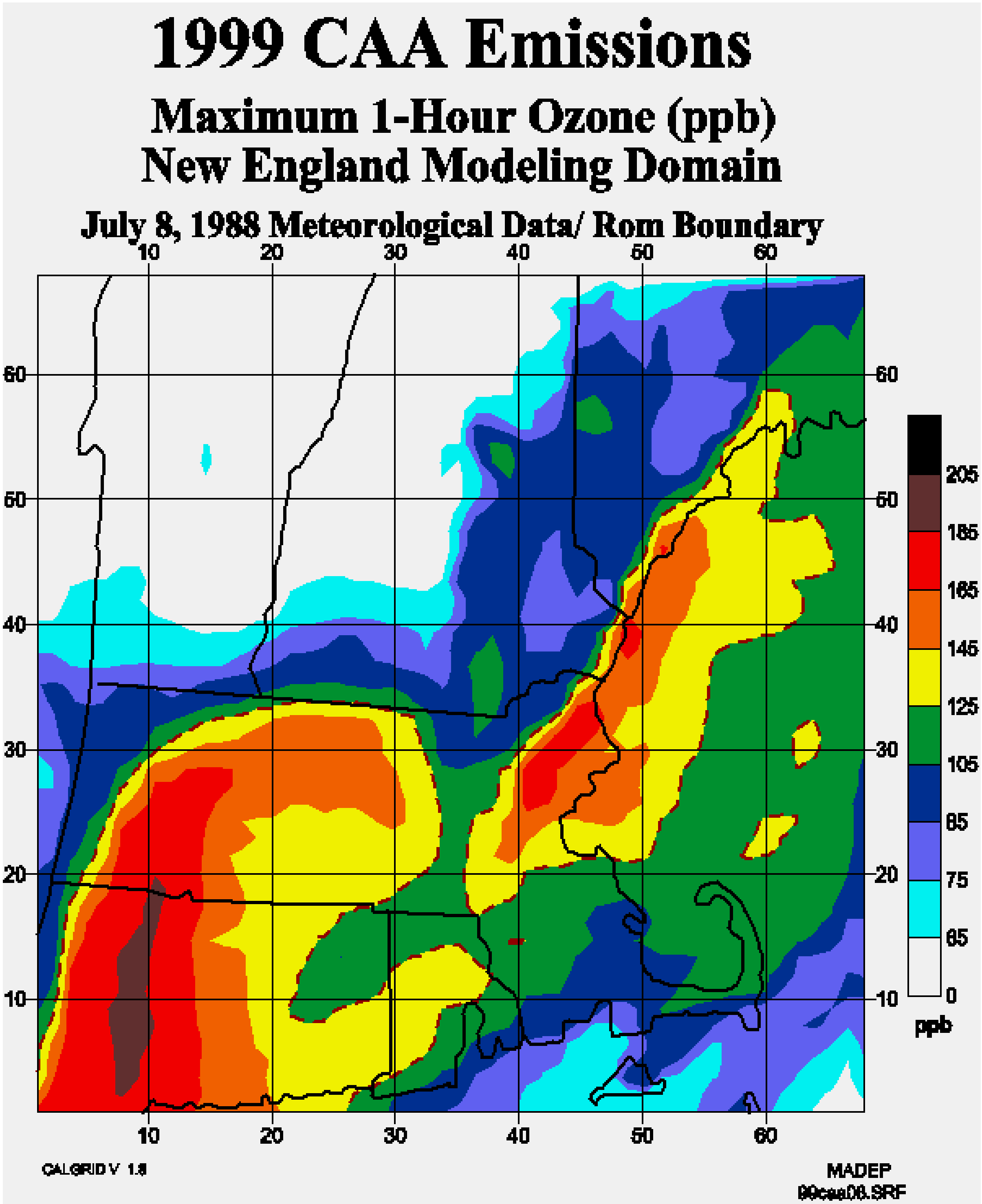

1999 CAA Emissions
Maximum 1-Hour Ozone (ppb)
New England Modeling Domain
July 8, 1988 Meteorological Data/ Rom Boundary
10
20
30
40
50
60
205
185
165
145
125
105
85
75
65
0
ppb
CALGRID V 1.8
MADEP
99caa08.SRF

Figure 3

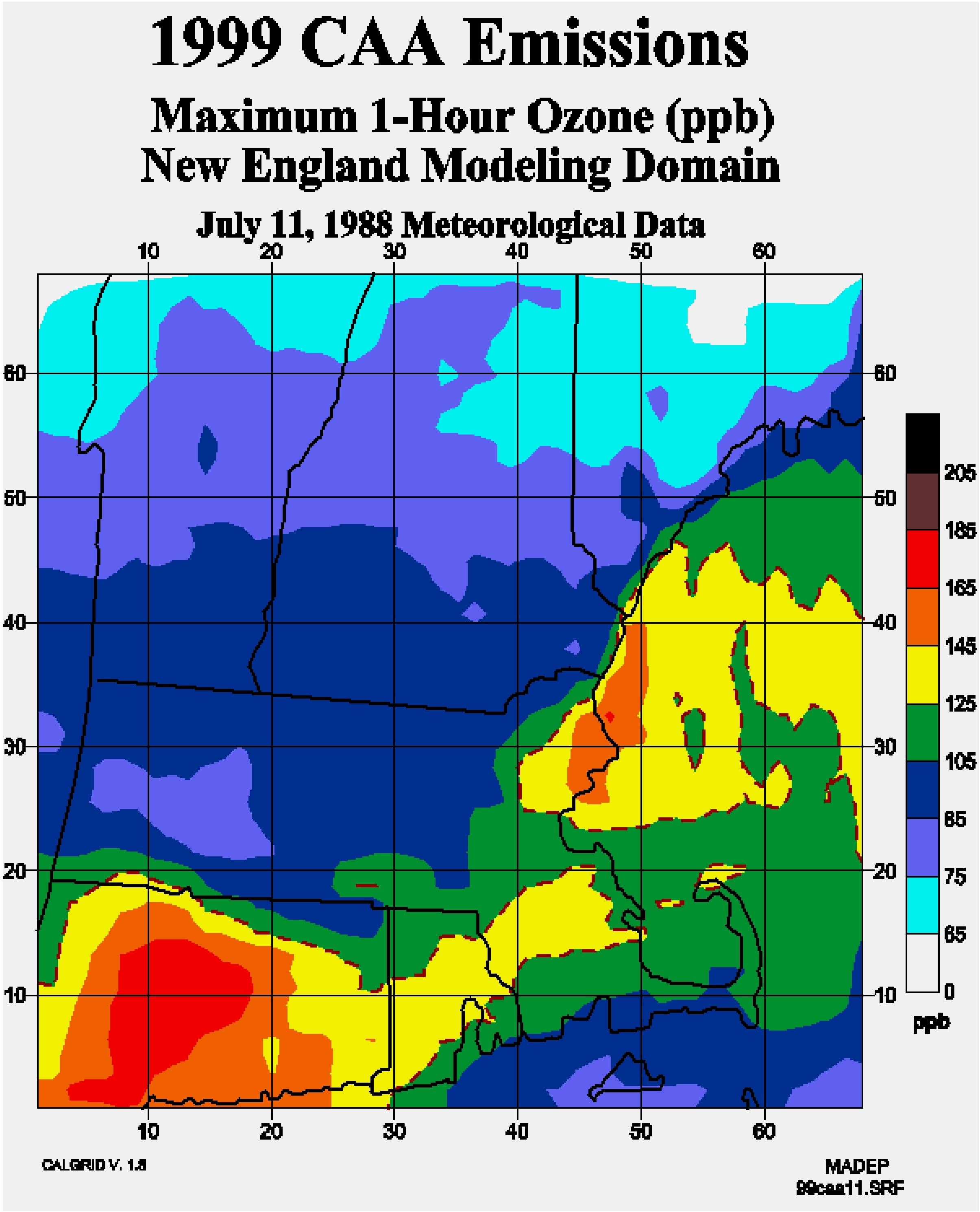
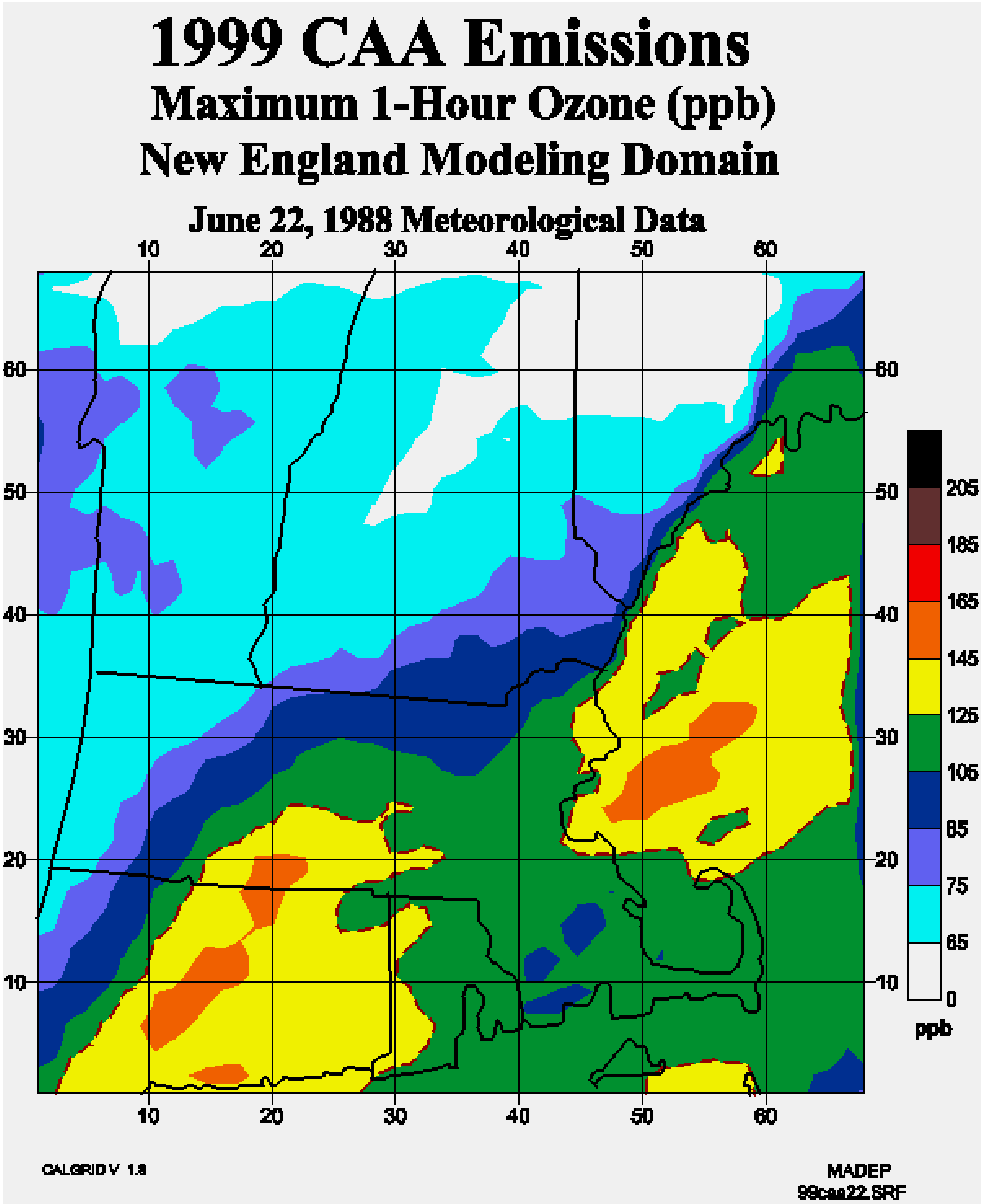

1999 CAA Emissions
Maximum 1-Hour Ozone (ppb)
New England Modeling Domain
July 11, 1988 Meteorological Data
10
20
30
40
50
60
205
185
165
145
125
105
85
75
65
0
ppb
CALGRID V. 1.8
MADEP
99caa11.SRF

Figure 4



1999 CAA Emissions
Maximum 1-Hour Ozone (ppb)
New England Modeling Domain
June 22, 1988 Meteorological Data
10
20
30
40
50
60
205
185
165
145
125
105
85
75
65
0
ppb
CALGRID V 1.8
MADEP
99caa22.SRF

Figure 5

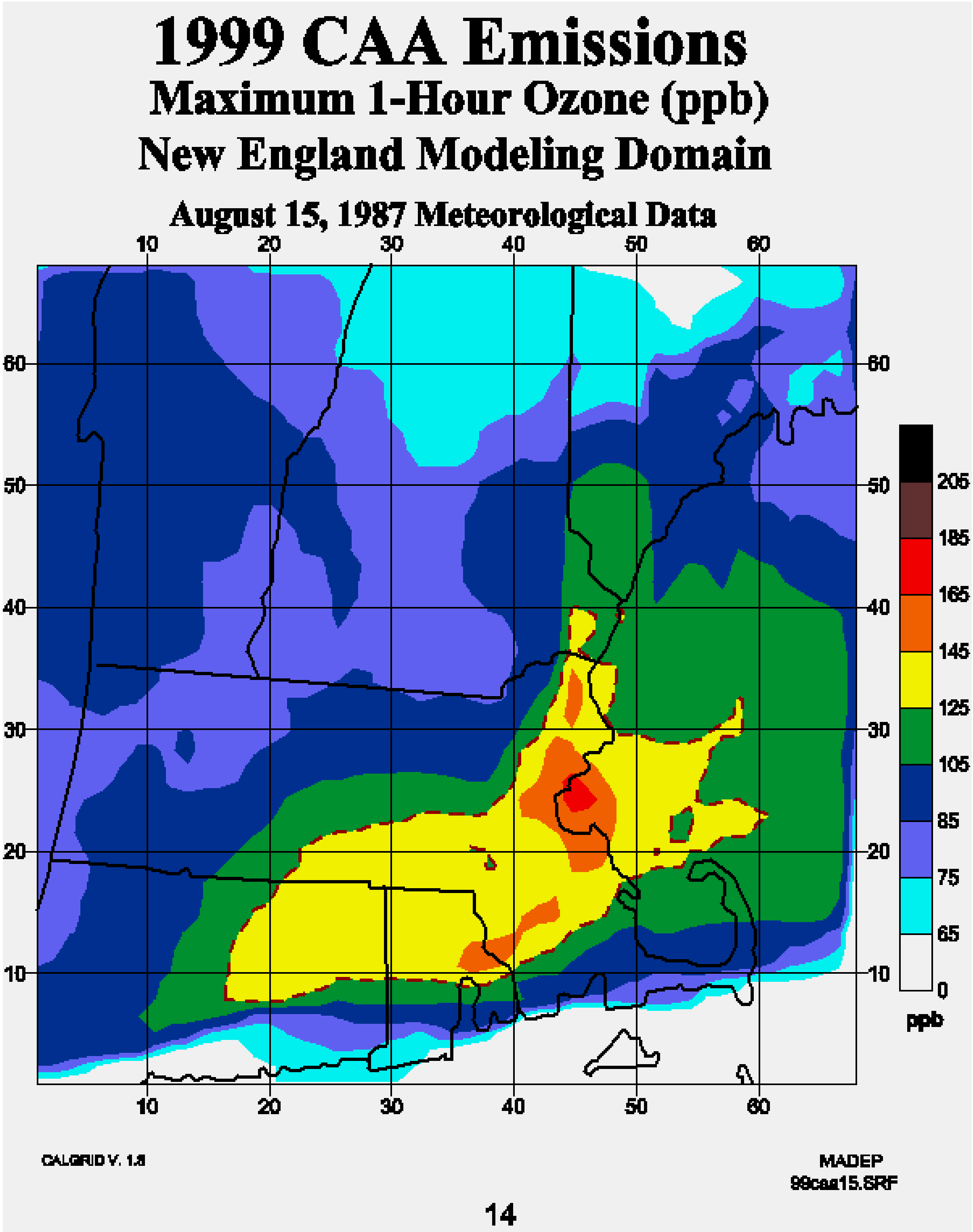

1999 CAA Emissions
Maximum 1-Hour Ozone (ppb)
New England Modeling Domain
August 15, 1987 Meteorological Data
10
20
30
40
50
60
205
185
165
145
125
105
85
75
65
0
ppb
CALGRID V. 1.6
MADEP
99caa15.SRF
14

Figure 6

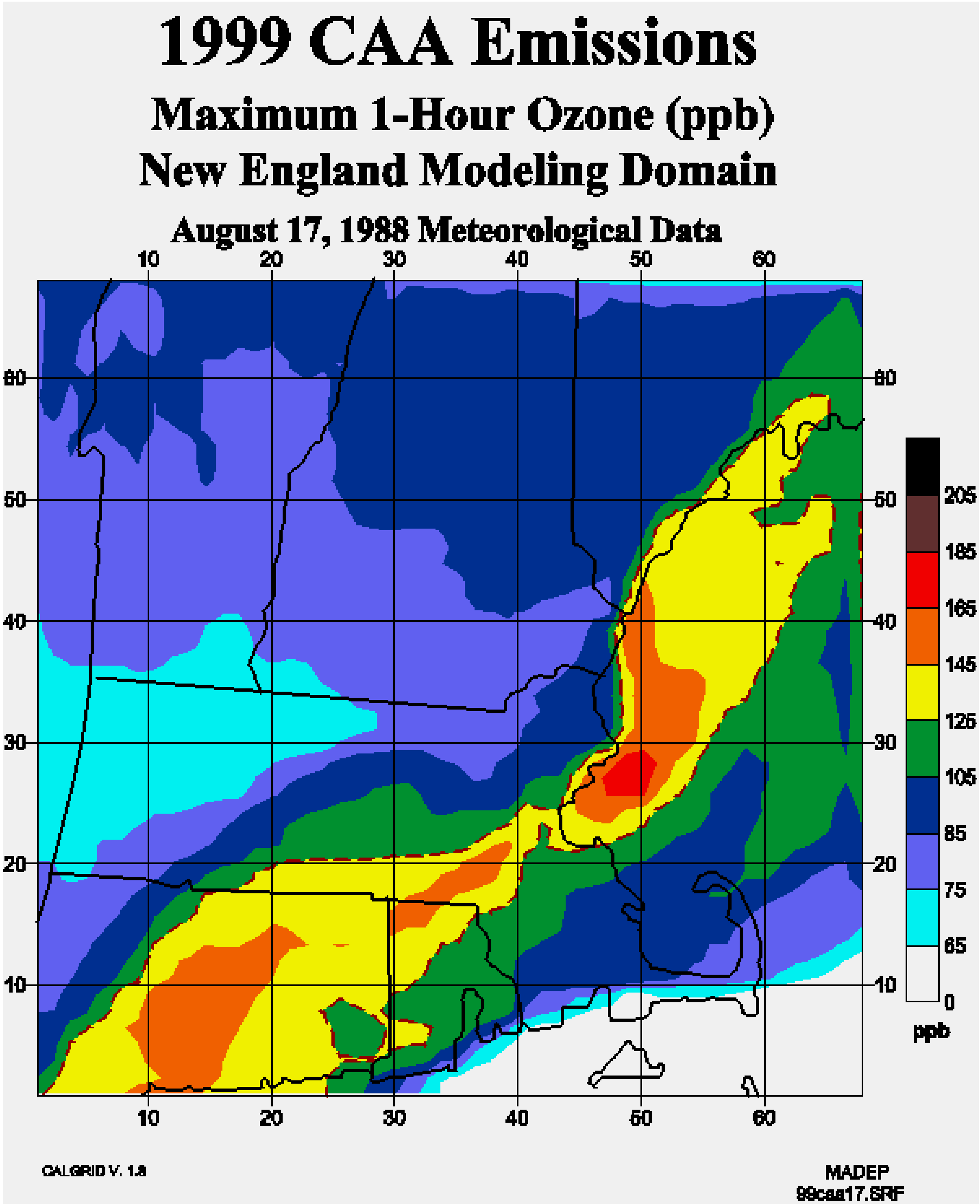
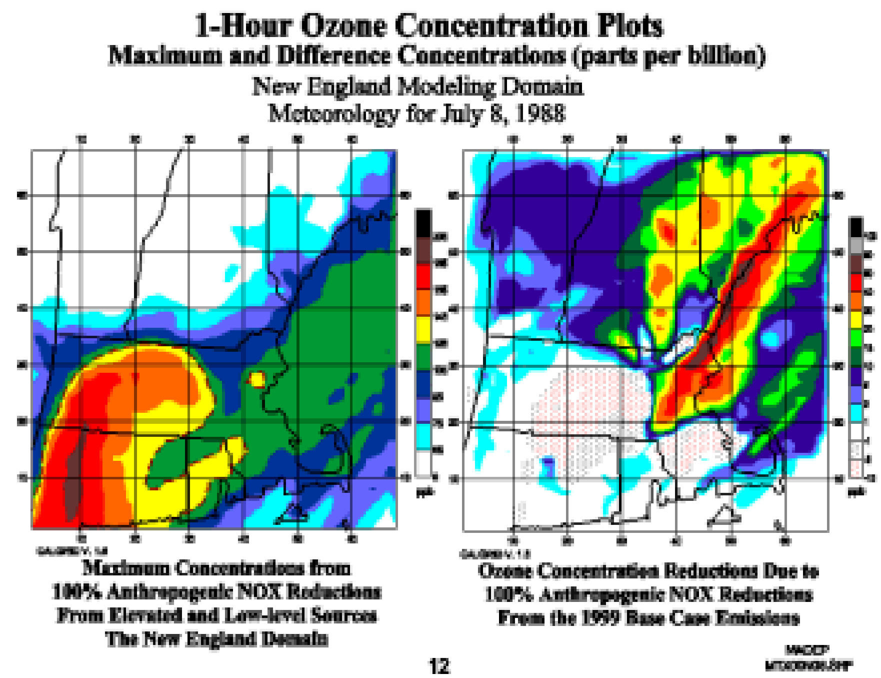

1999 CAA Emissions
Maximum 1-Hour Ozone (ppb)
New England Modeling Domain
August 17, 1988 Meteorological Data
10
20
30
40
50
60
205
185
165
145
125
105
85
75
65
0
ppb
CALGRID V. 1.8
MADEP
99caa17.SRF

Figure 7
Effect of 100% Reduction in NOx (top) and VOC (bottom)
in the New England Domain (July 8, 1988 Episode)



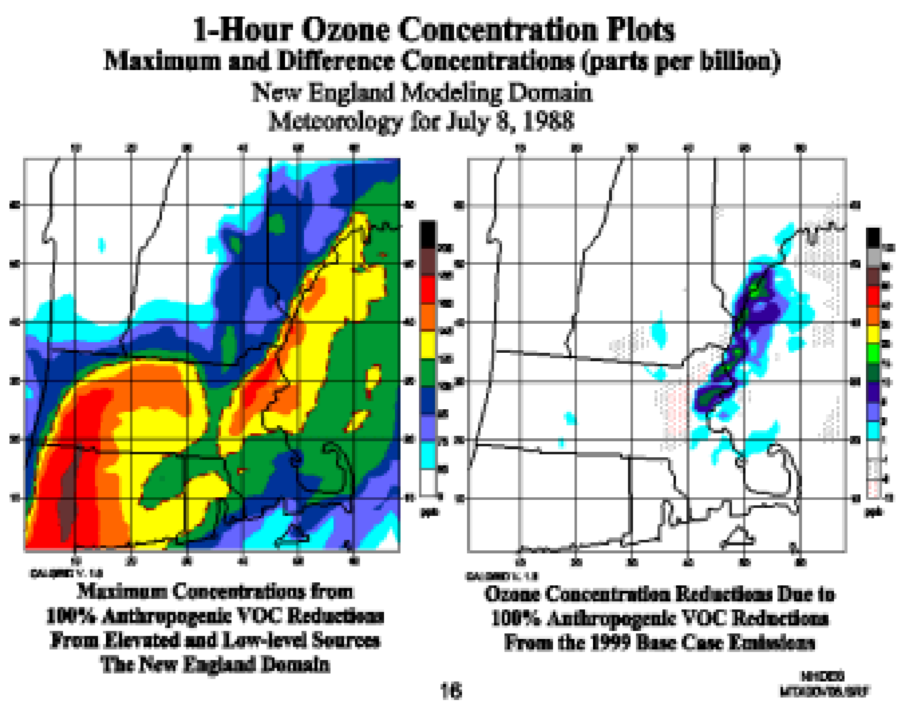
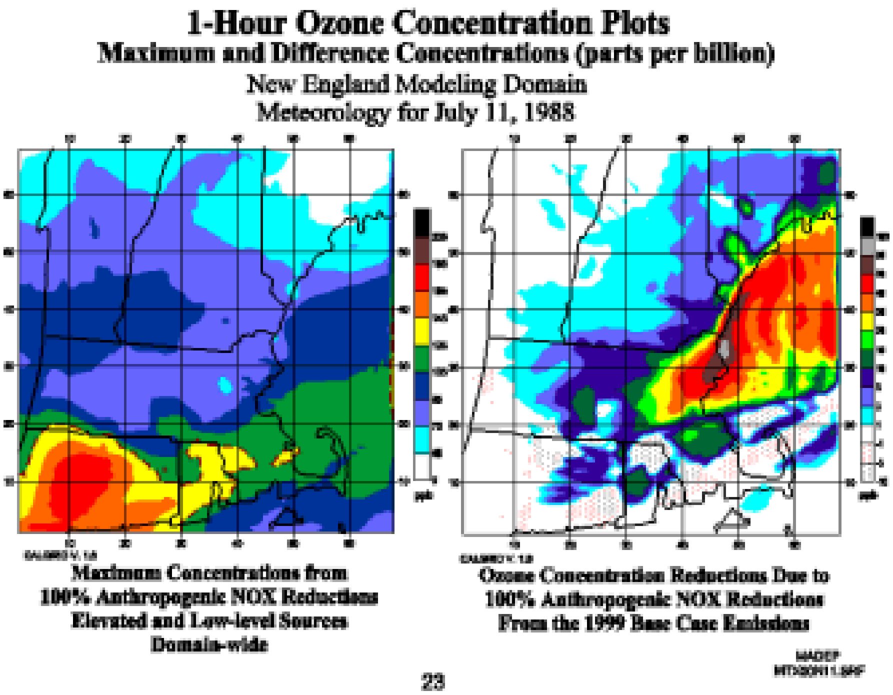


Figure 8
Effect of 100% Reduction in NOx (top) and VOC (bottom)
in the New England Domain (July 11, 1988 Episode)



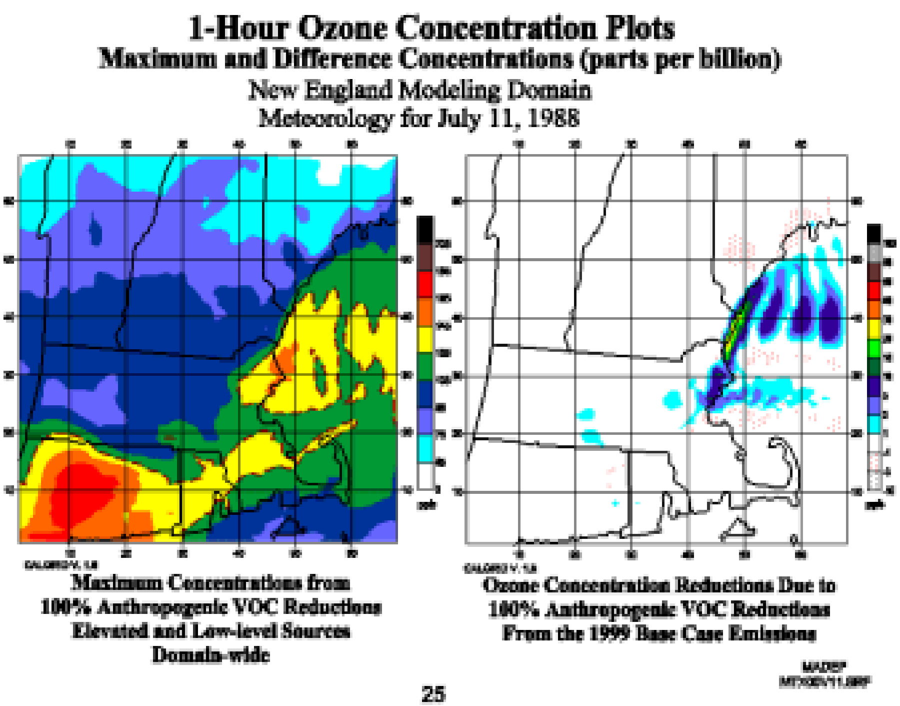


Figure 9
Effect of 100% Reduction in NOx (top) and VOC (bottom)
in the New England Domain (June 22, 1988 Episode)

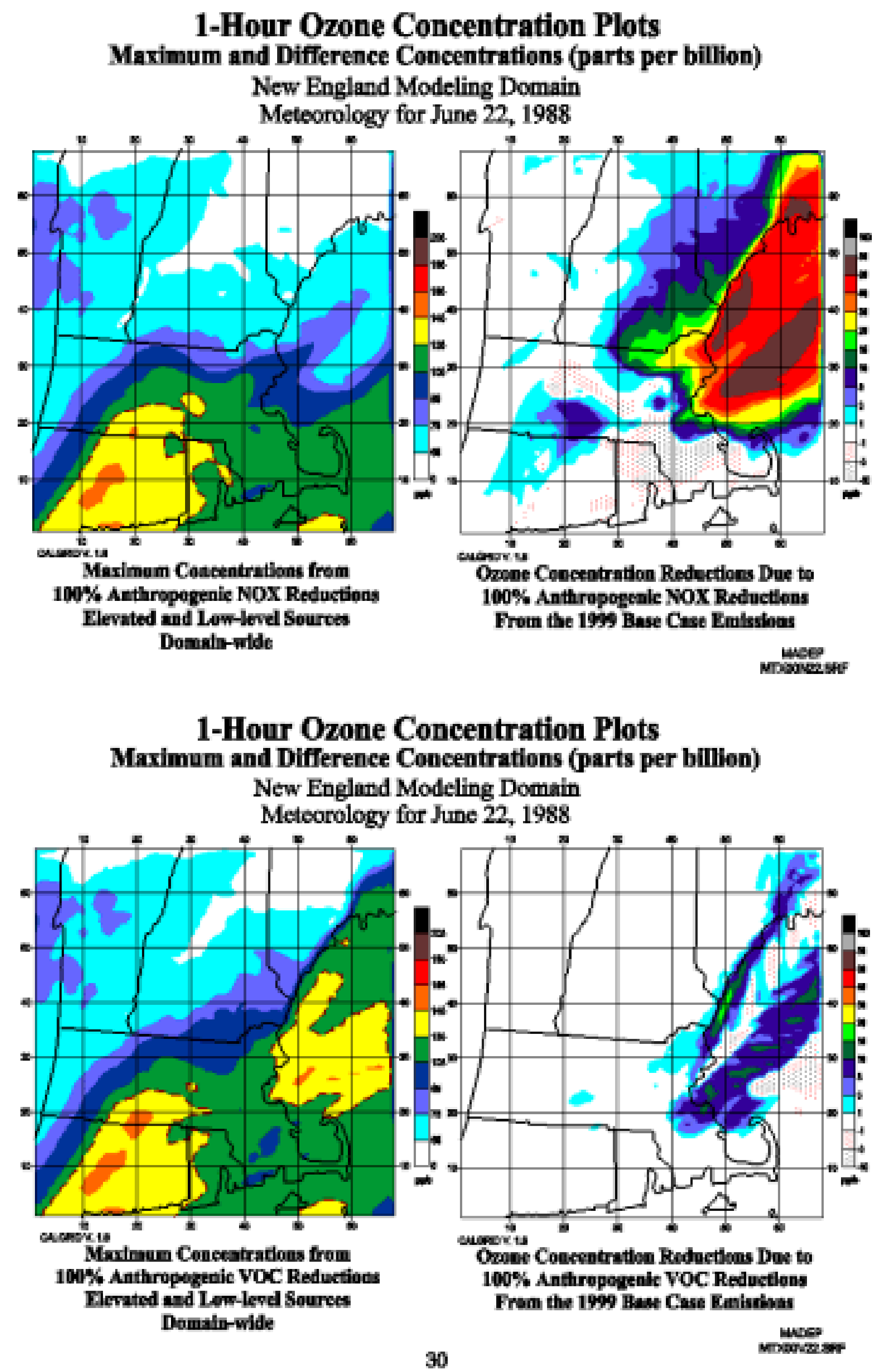
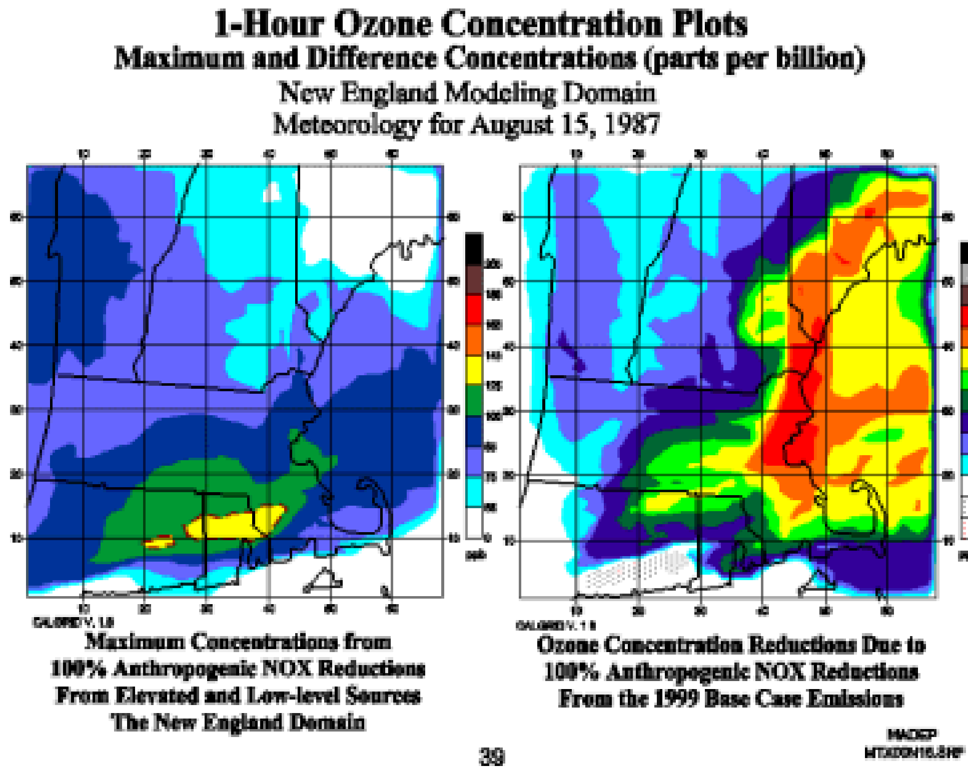


Figure 10
Effect of 100% Reduction in NOx (top) and VOC (bottom)
in the New England Domain (August 15, 1987 Episode)



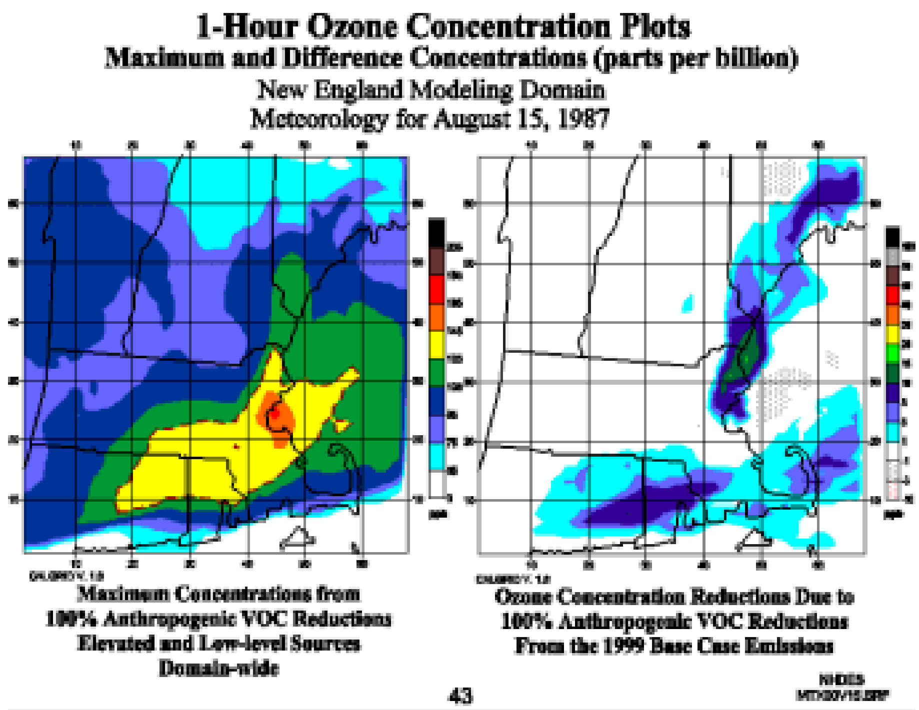
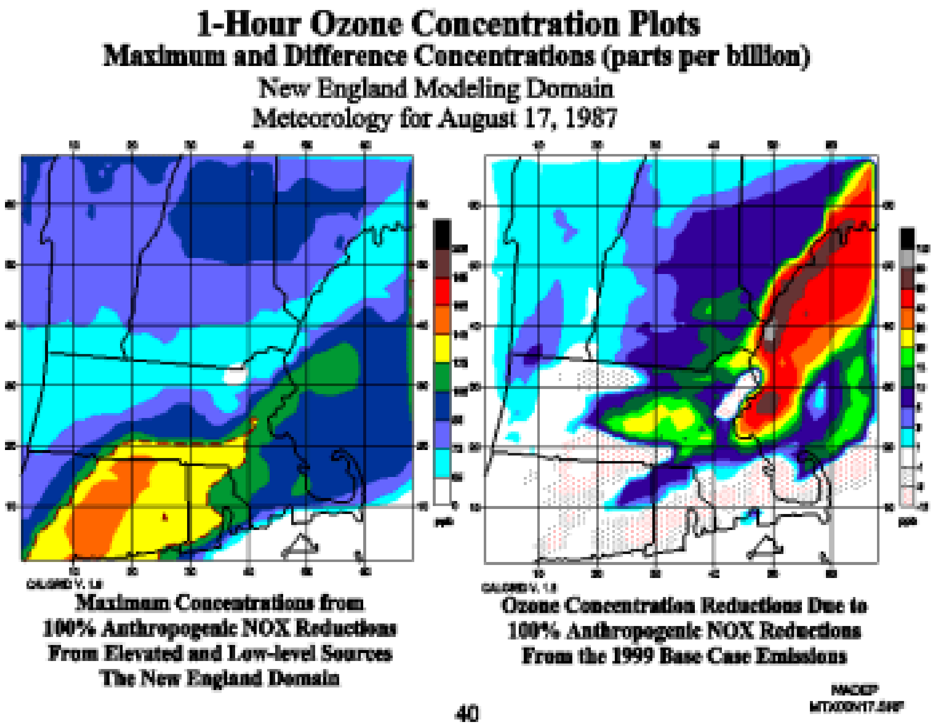


Figure 11
Effect of 100% Reduction in NOx (top) and VOC (bottom)
in the New England Domain (August 17, 1987 Episode)



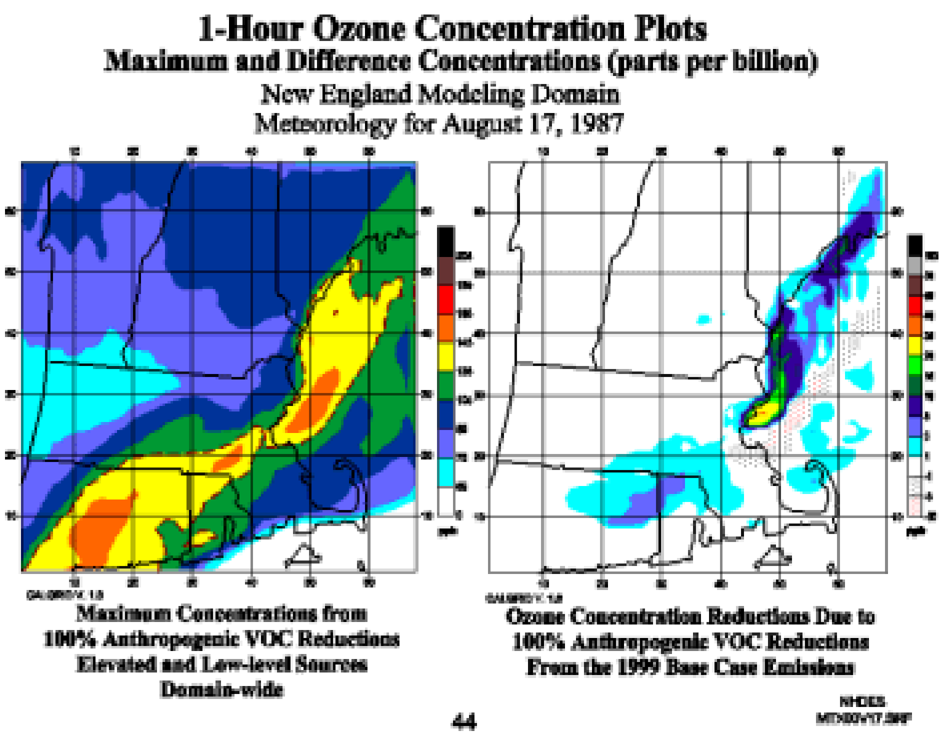


Figure 12
Maximum and Difference Plots for July 8, 1988 Episode
NOx SIP Call Emissions in the Domain and in Upwind Areas

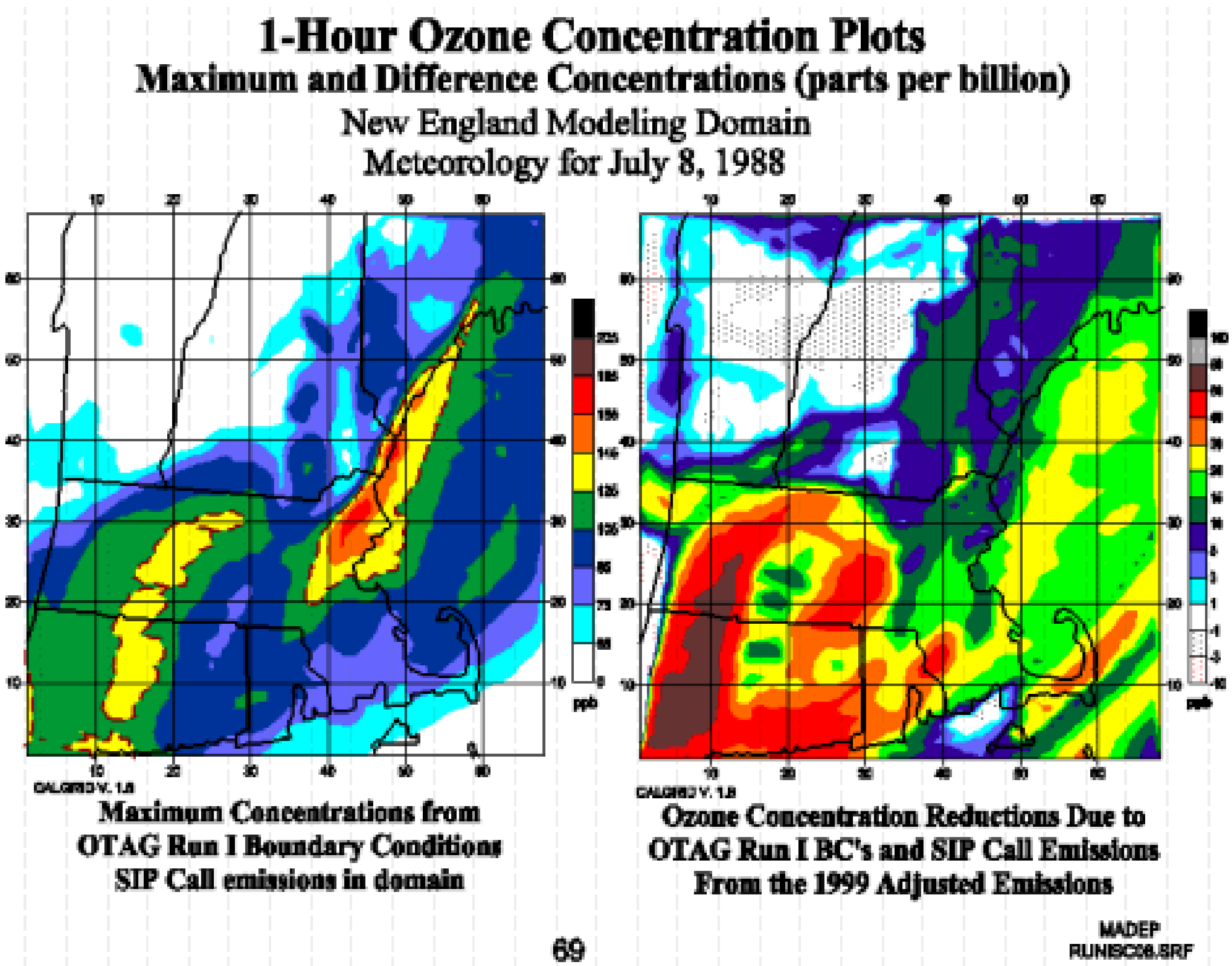


Figure 13

Maximum and Difference Plots for July 11, 1988 Episode
NOx SIP Call Emissions in the Domain and in Upwind Areas

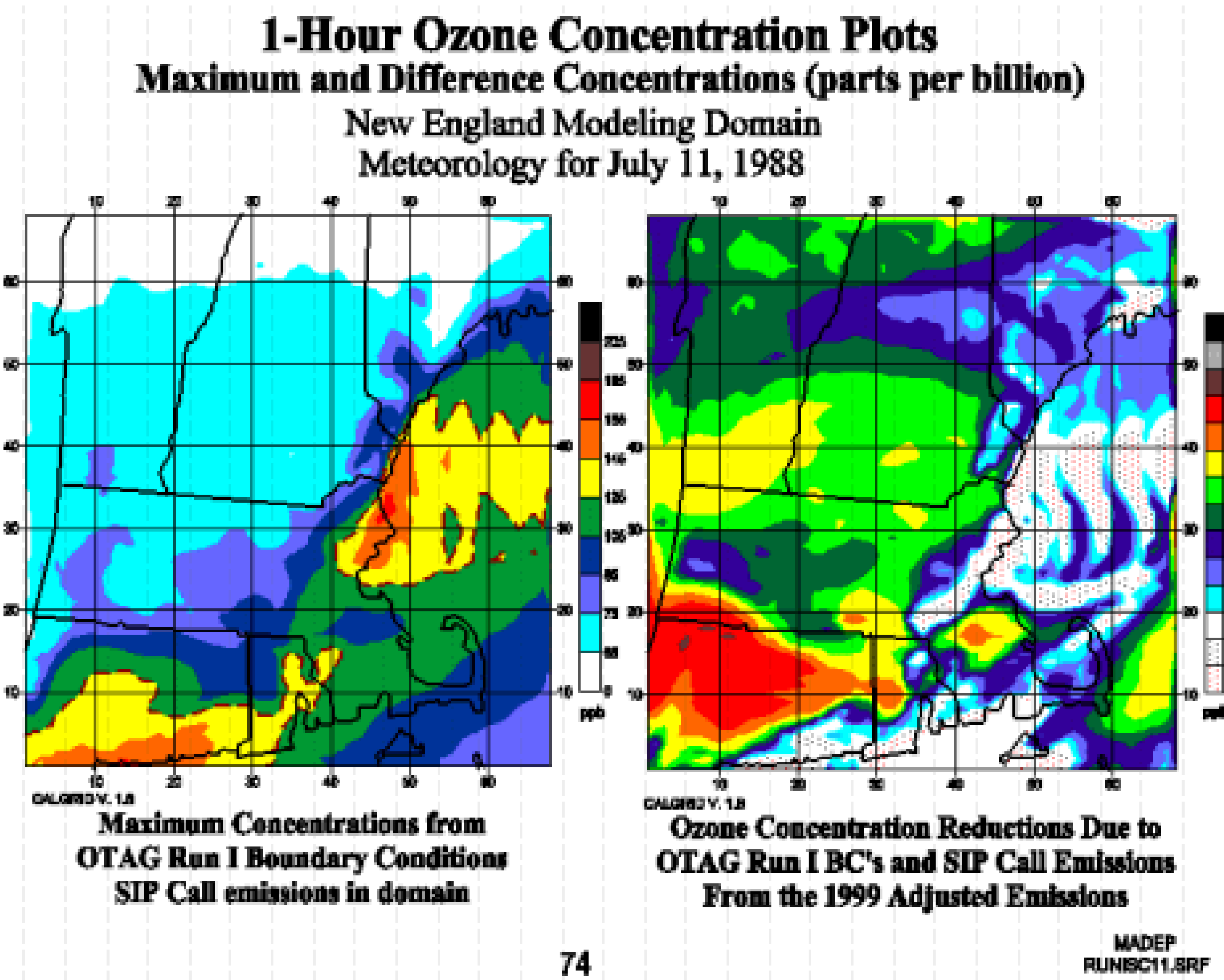


Figure 14

Back Trajectory Analysis for 9 August 2001
Maximum One-Hour Ozone Level at Narragansett – 150 ppb

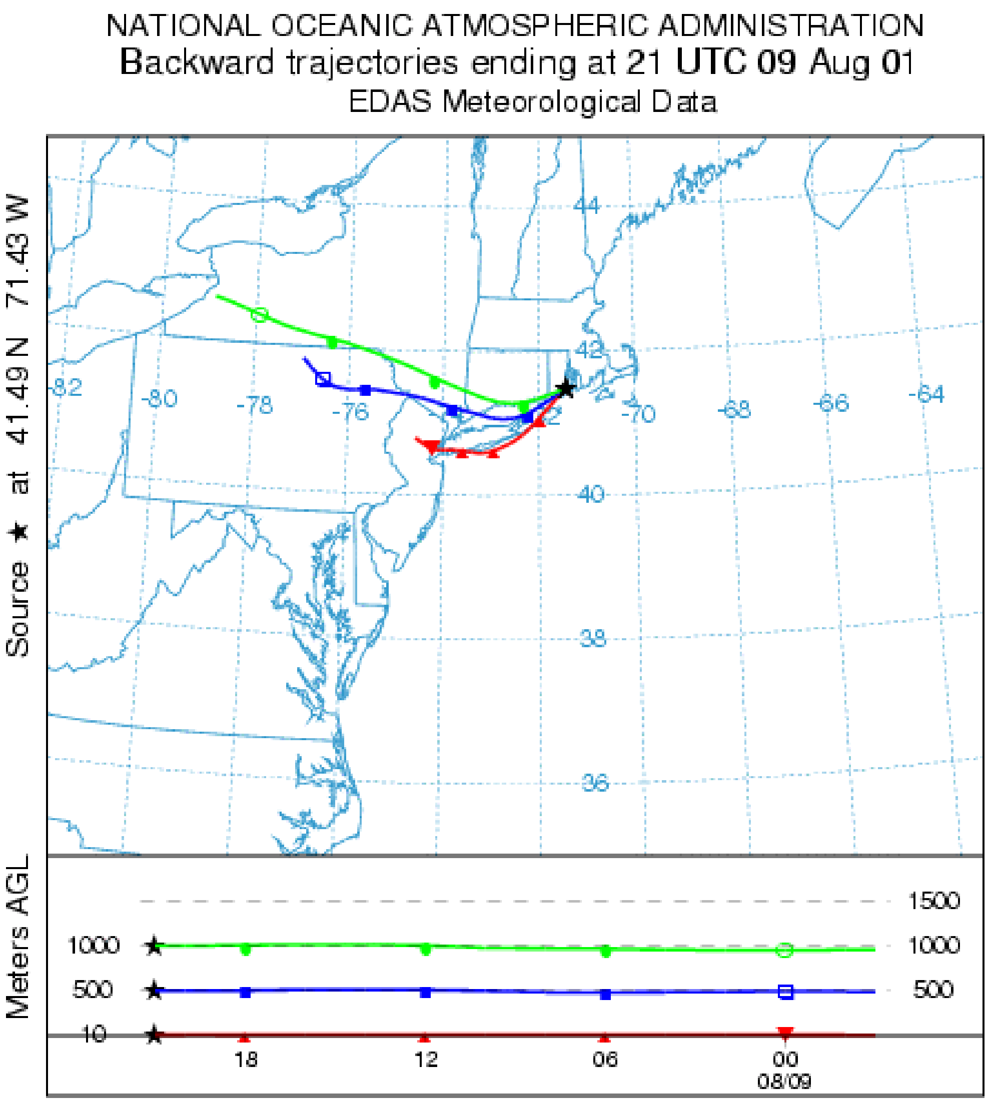


Figure 15

Back Trajectory Analysis for 10 June 2000
Maximum One-Hour Ozone Level at Narragansett – 149 ppb

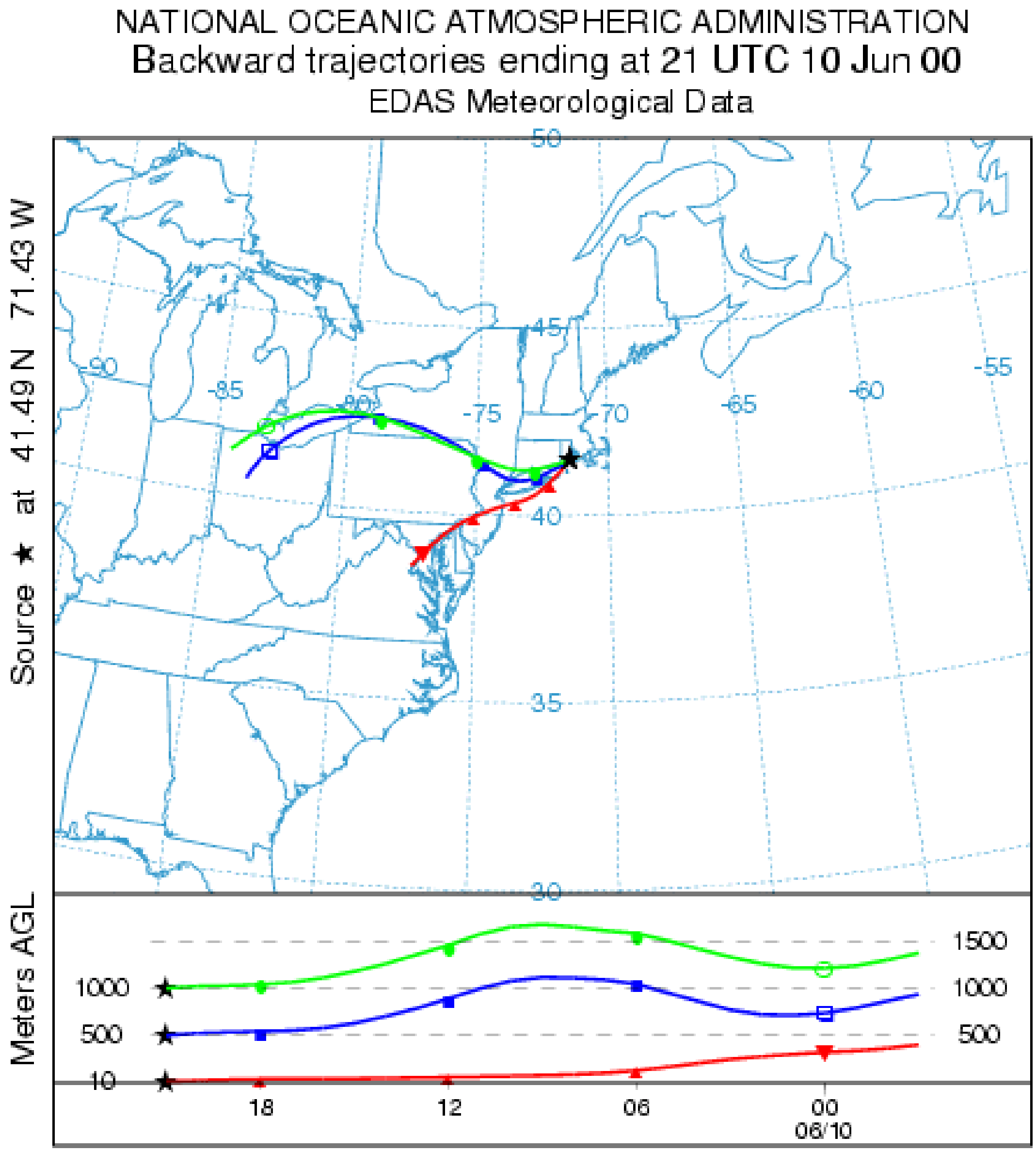


Figure 16

Back Trajectory Analysis for 6 July 1999
Maximum One-Hour Ozone Level at Narragansett – 144 ppb

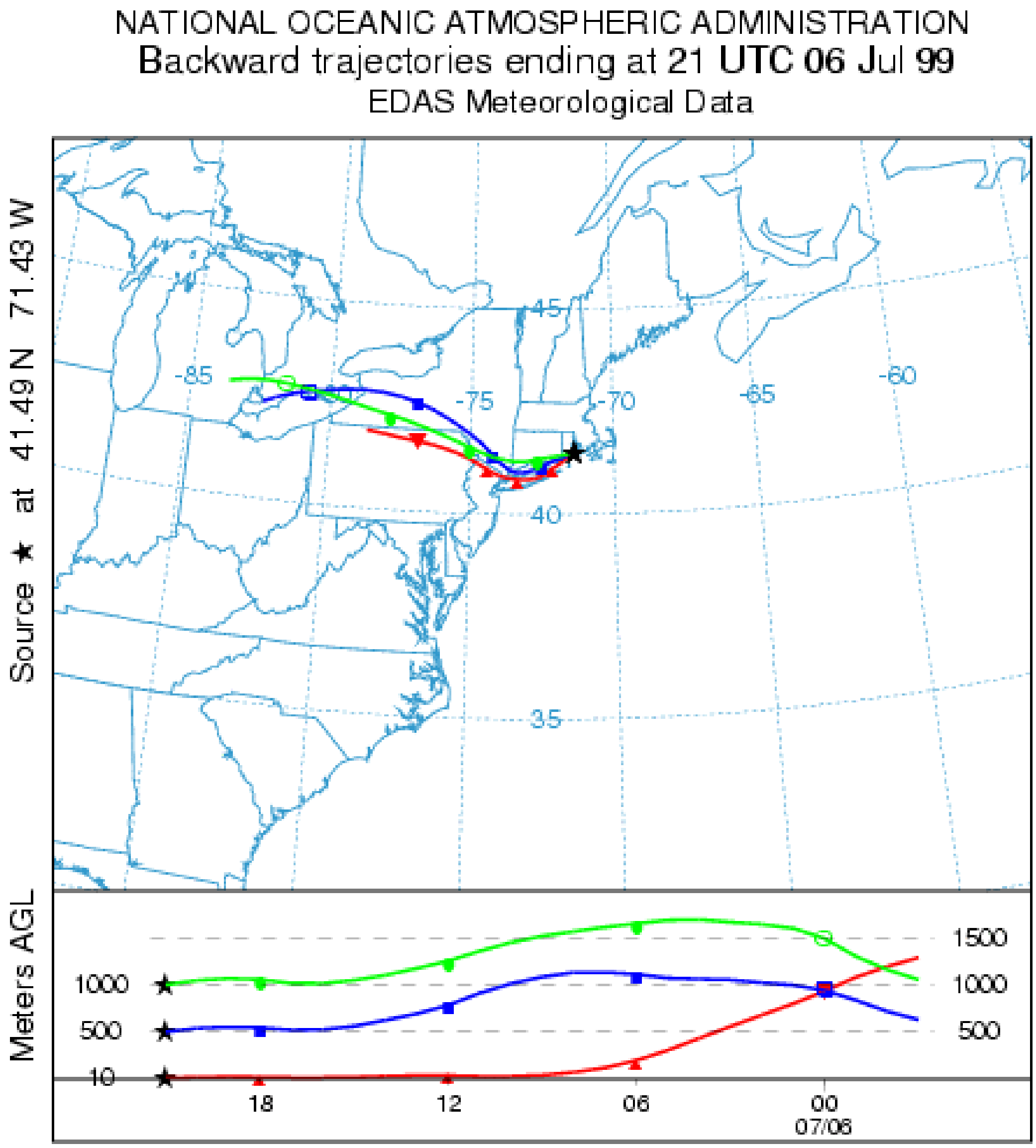


Figure 17

Back Trajectory Analysis for 7 August 2001
Maximum One-Hour Ozone Level at Narragansett – 144 ppb

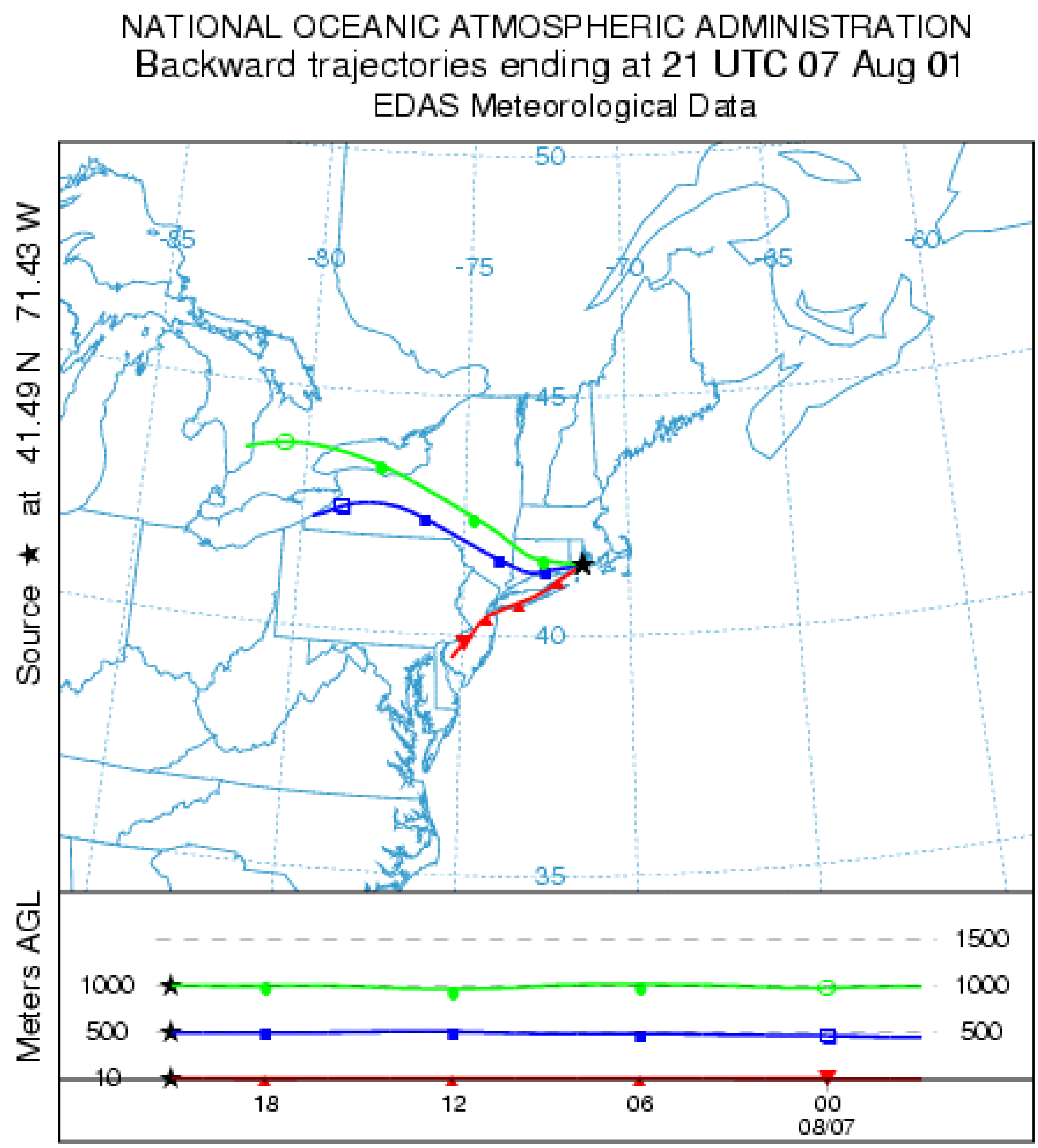


Figure 18

Back Trajectory Analysis for 9 July 2002
Maximum One-Hour Ozone Level at W. Greenwich – 142 ppb

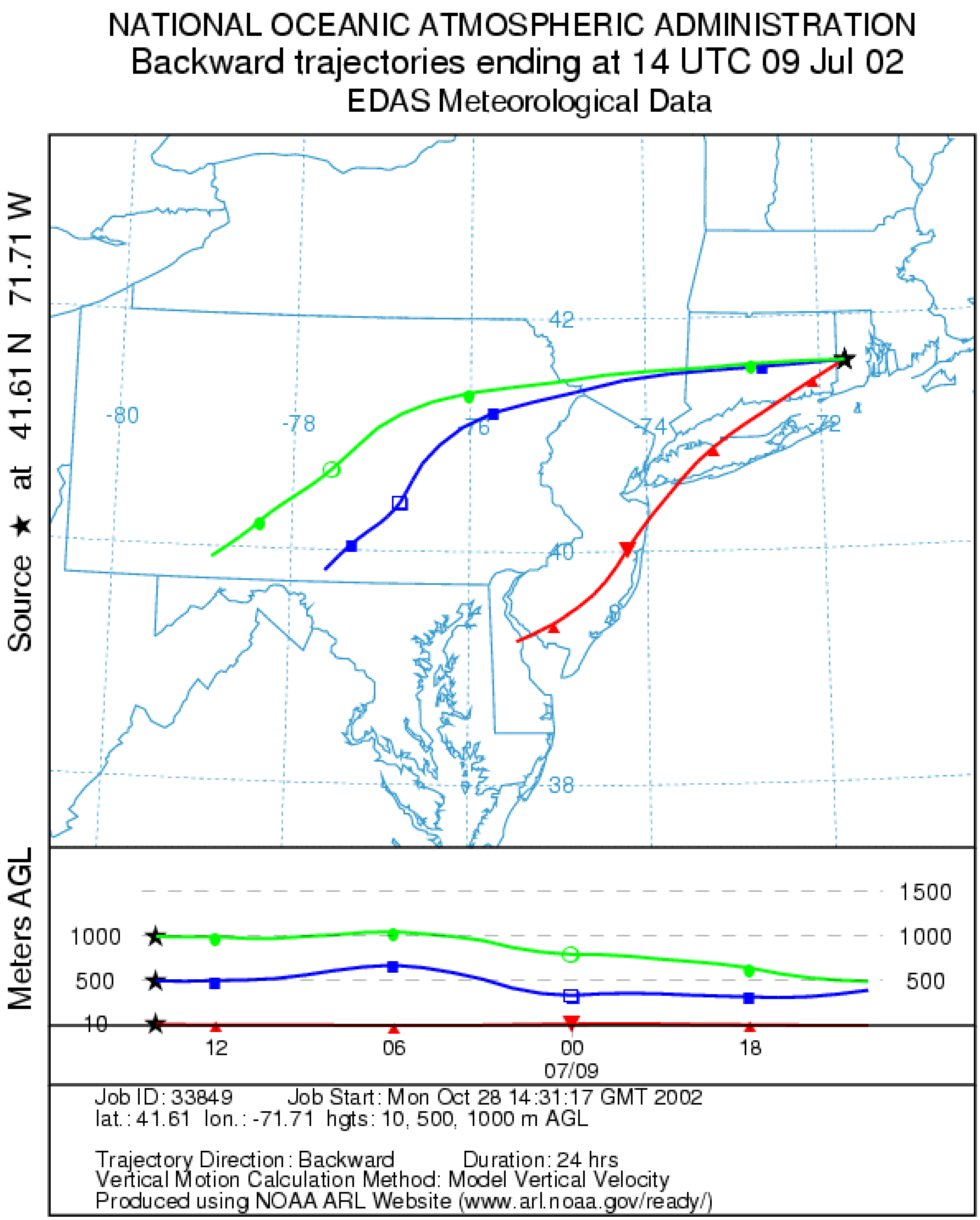


Figure 19

Back Trajectory Analysis for 30 June 2001
Maximum One-Hour Ozone Level at W. Greenwich – 136 ppb

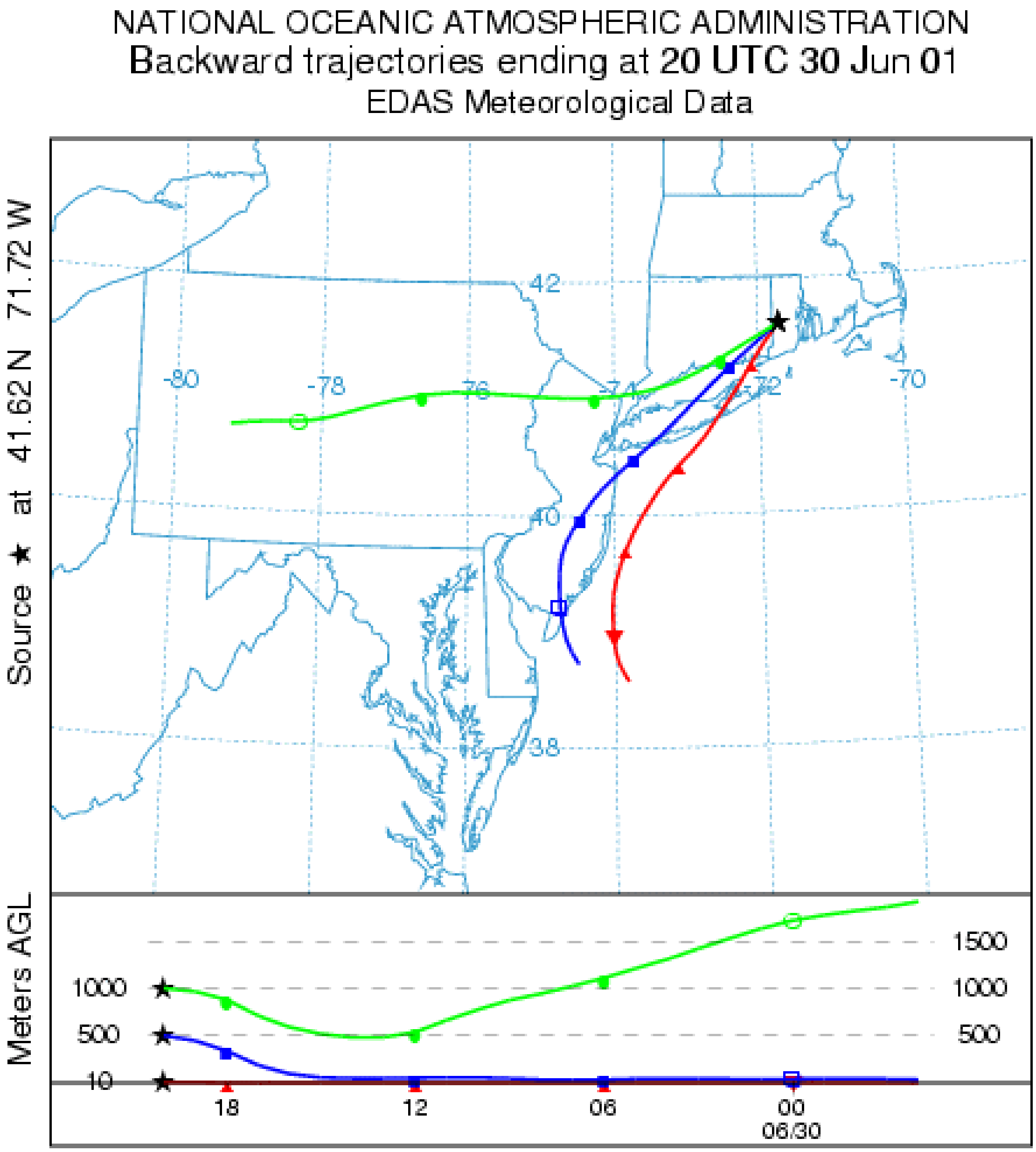


Figure 20

Back Trajectory Analysis for 7 June 1999
Maximum One-Hour Ozone Level at Narragansett – 133 ppb

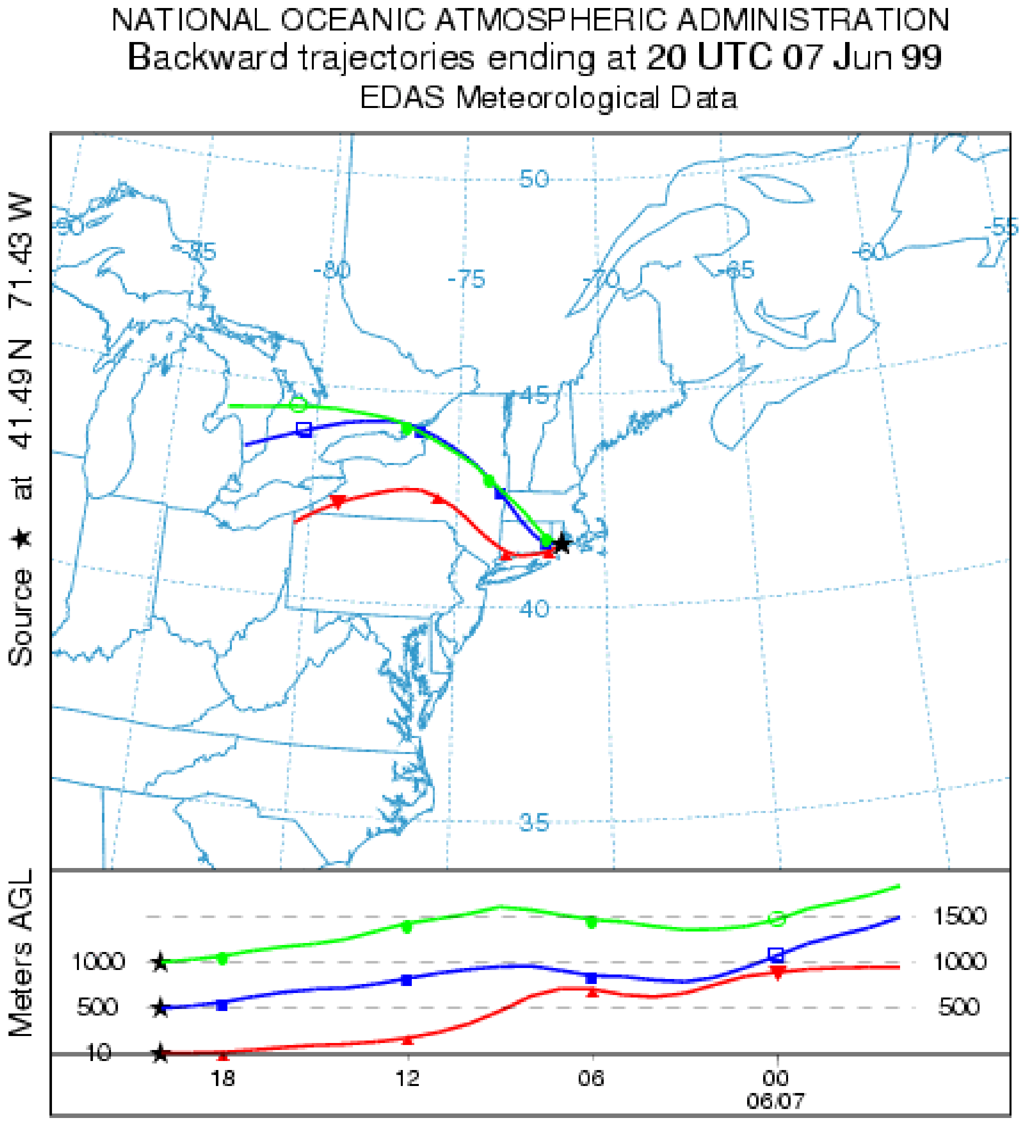


Figure 21

Back Trajectory Analysis for 16 July 1999
Maximum One-Hour Ozone Level at W. Greenwich – 131 ppb

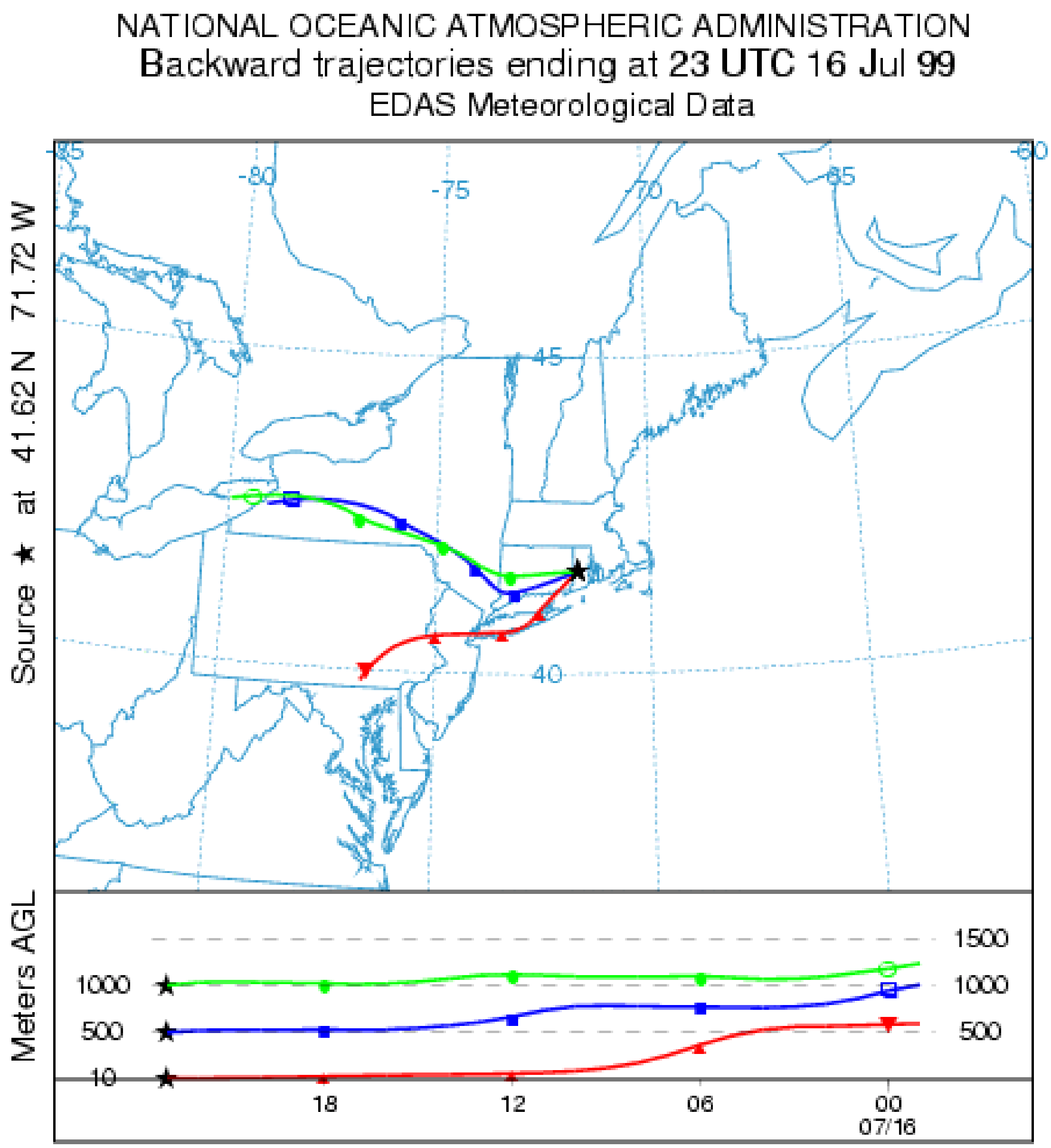


Figure 22

Back Trajectory Analysis for 13 August 2002
Maximum One-Hour Ozone Level at E. Providence – 131 ppb

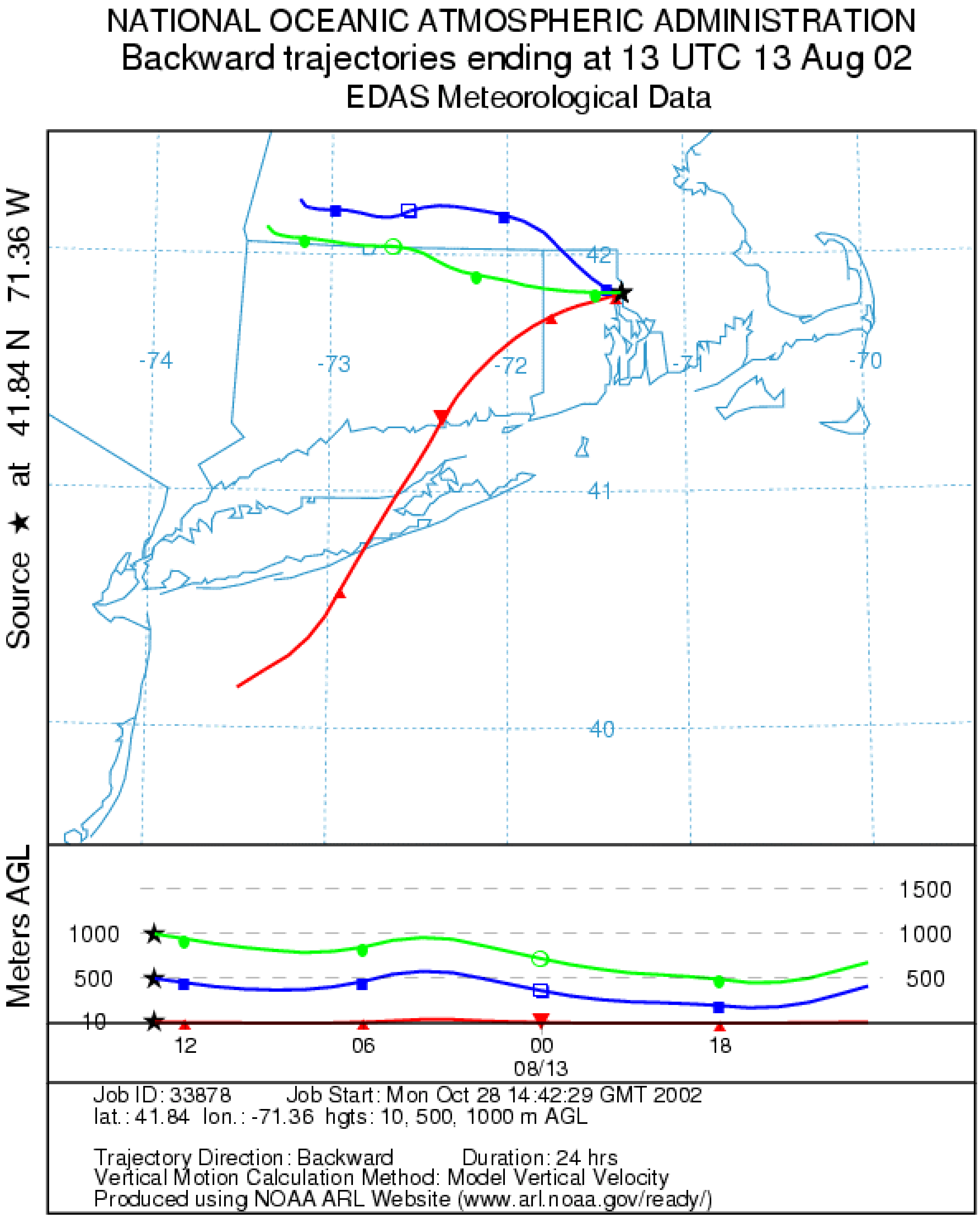


Figure 23

Back Trajectory Analysis for 25 July 2001
Maximum One-Hour Ozone Level at W. Greenwich – 127 ppb

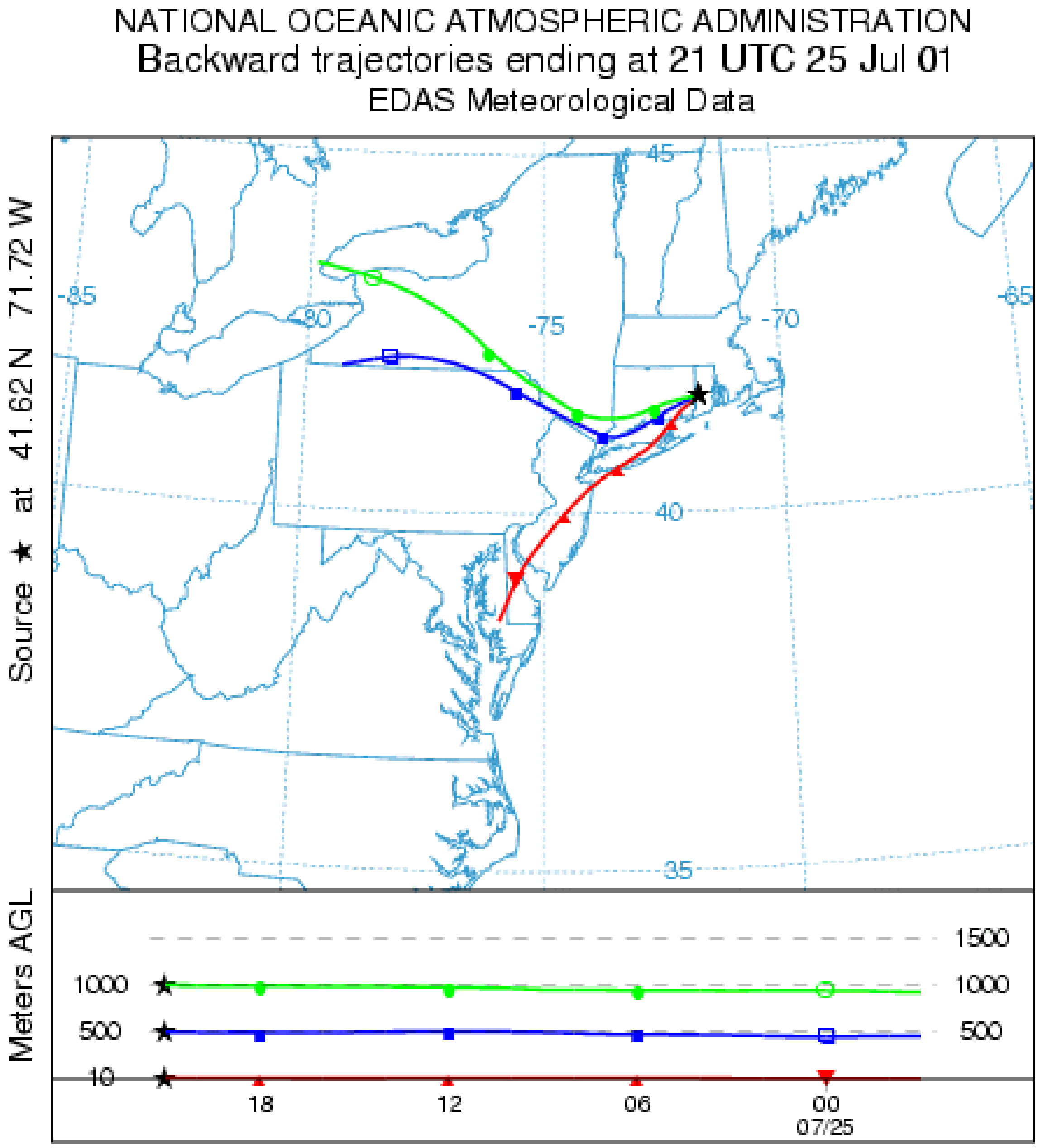
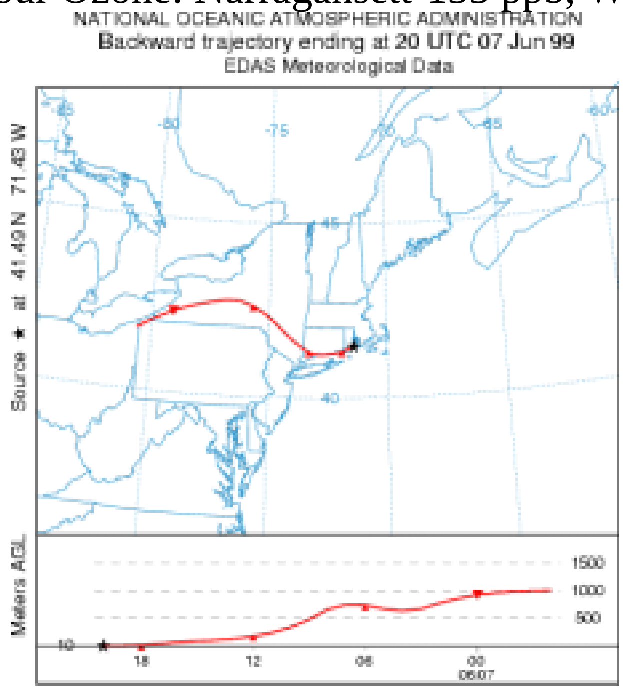


Figure 24

Comparison of Near-Surface Back Trajectories
for Narragansett, RI (top) and Worcester, MA (bottom) for 7 June 1999
Maximum 1-Hour Ozone: Narragansett-133 ppb, Worcester-69 ppb



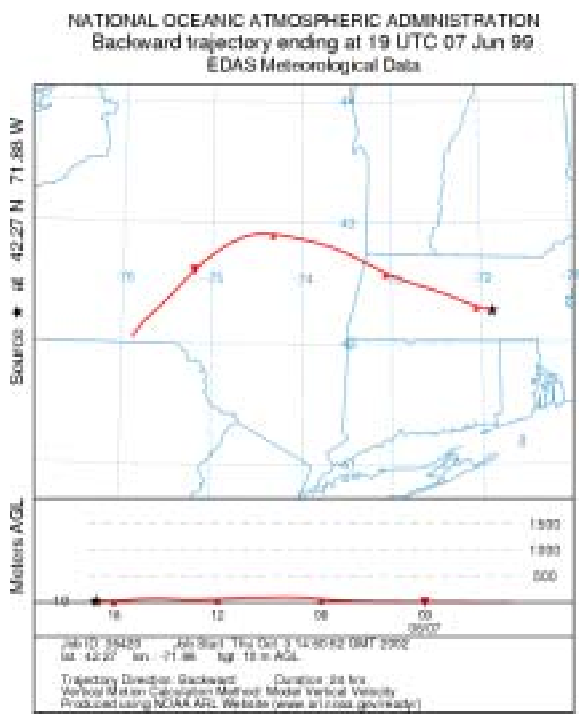
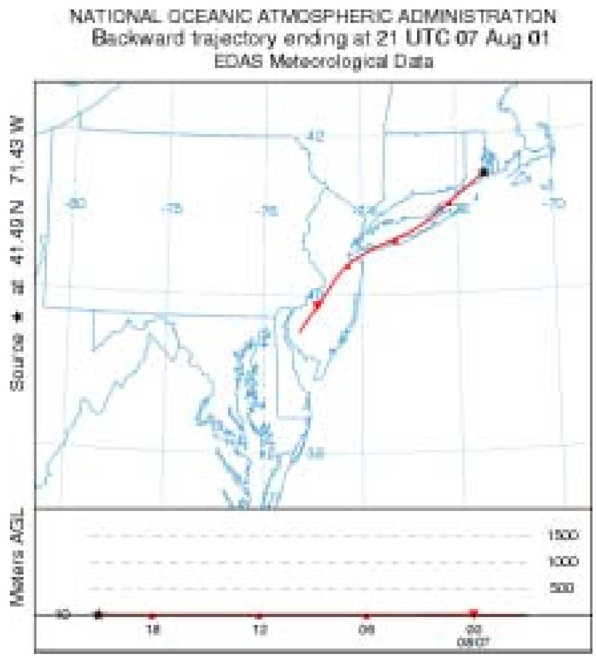


Figure 25

Comparison of Near-Surface Back Trajectories for
Narragansett, RI (top) and Worcester, MA (bottom) for 7 August 2001
Maximum 1-Hour Ozone: Narragansett-144 ppb, Worcester-80 ppb



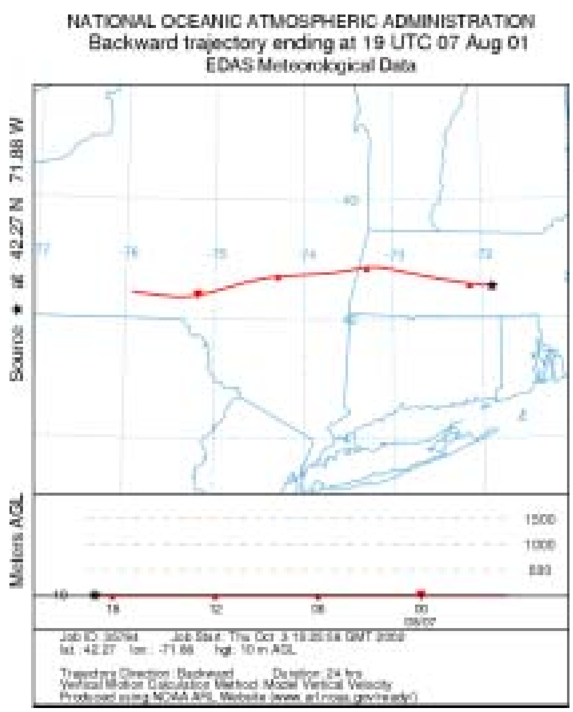


Figure 26

Comparison of Near-Surface Back Trajectories for
Narragansett, RI (top) and Worcester, MA (bottom) for 17 August 1999
Maximum 1-Hour Ozone: Narragansett- 48 ppb, Worcester-113 ppb

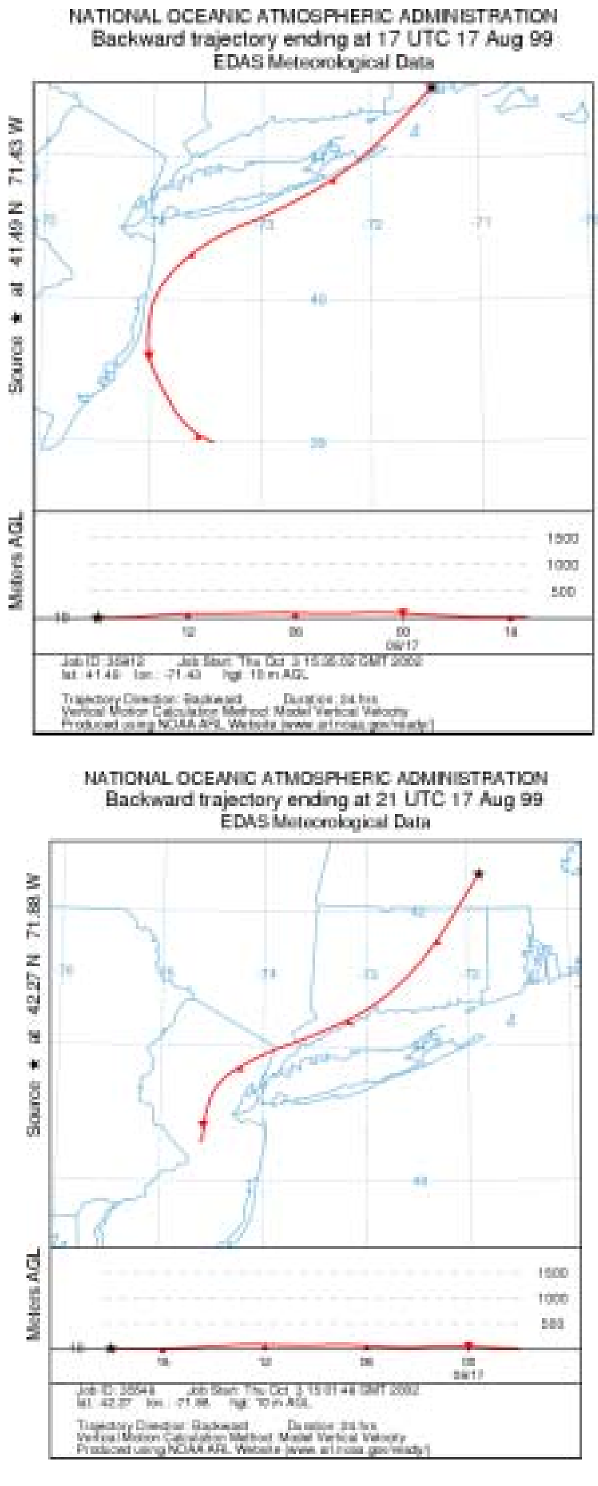
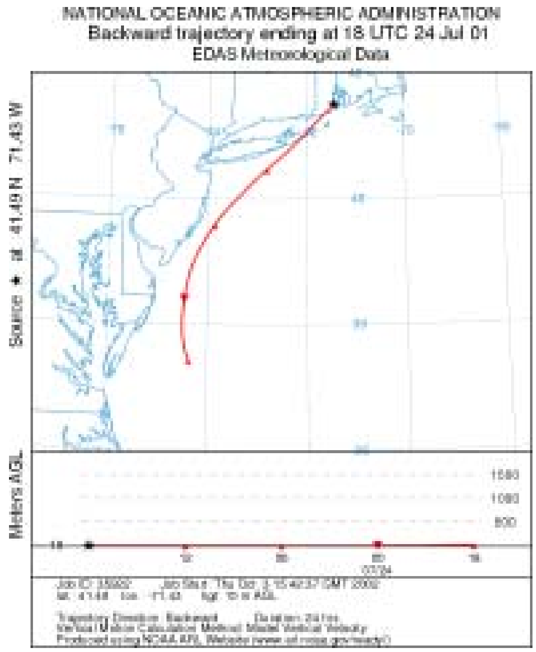


Figure 27

Comparison of Near-Surface Back Trajectories
for Narragansett, RI (top) and Worcester, MA (bottom) for 24 July 2001
Maximum 1-Hour Ozone: Narragansett- 53 ppb, Worcester-121 ppb



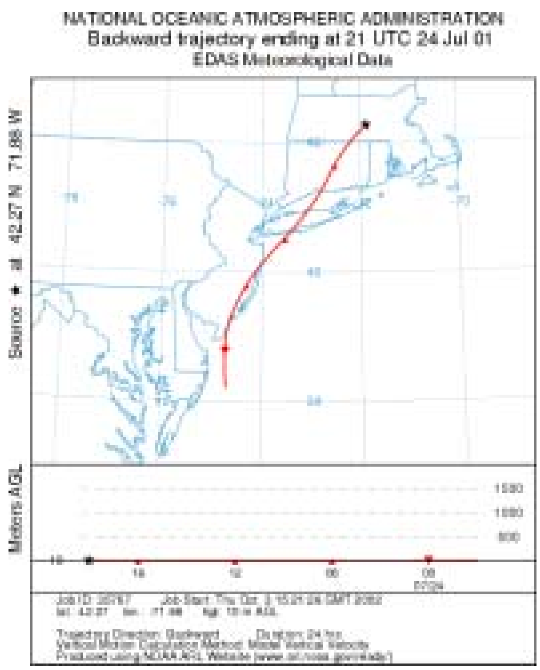


Figure 28

Maximum and Difference Plots for July 8, 1988 Episode
NOx SIP Call Emissions in Upwind Areas and
1999 Clean Air Act Emissions in Domain

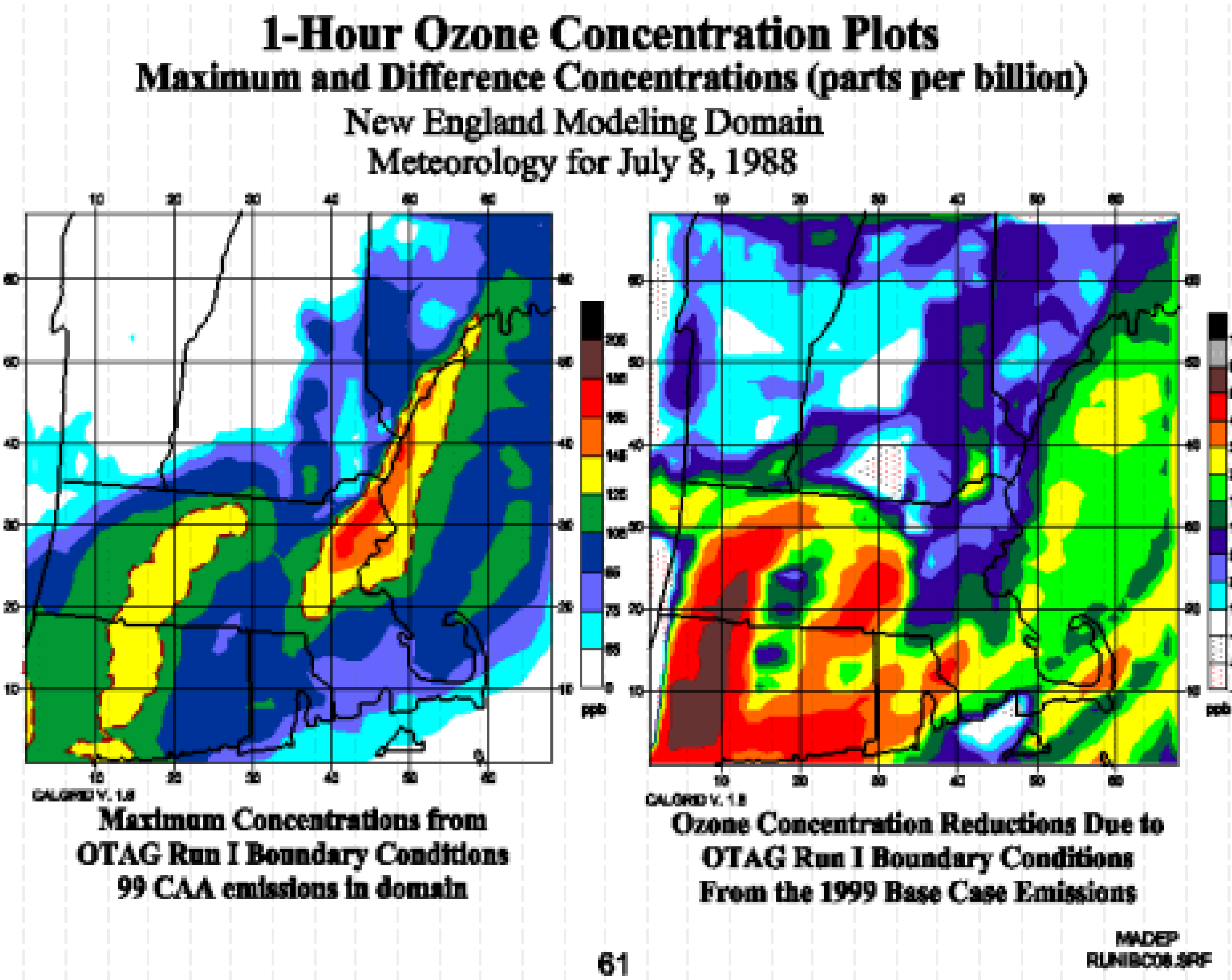


Figure 29

Maximum and Difference Plots for July 11, 1988 Episode
NOx SIP Call Emissions in Upwind Areas and
1999 Clean Air Act Emissions in Domain

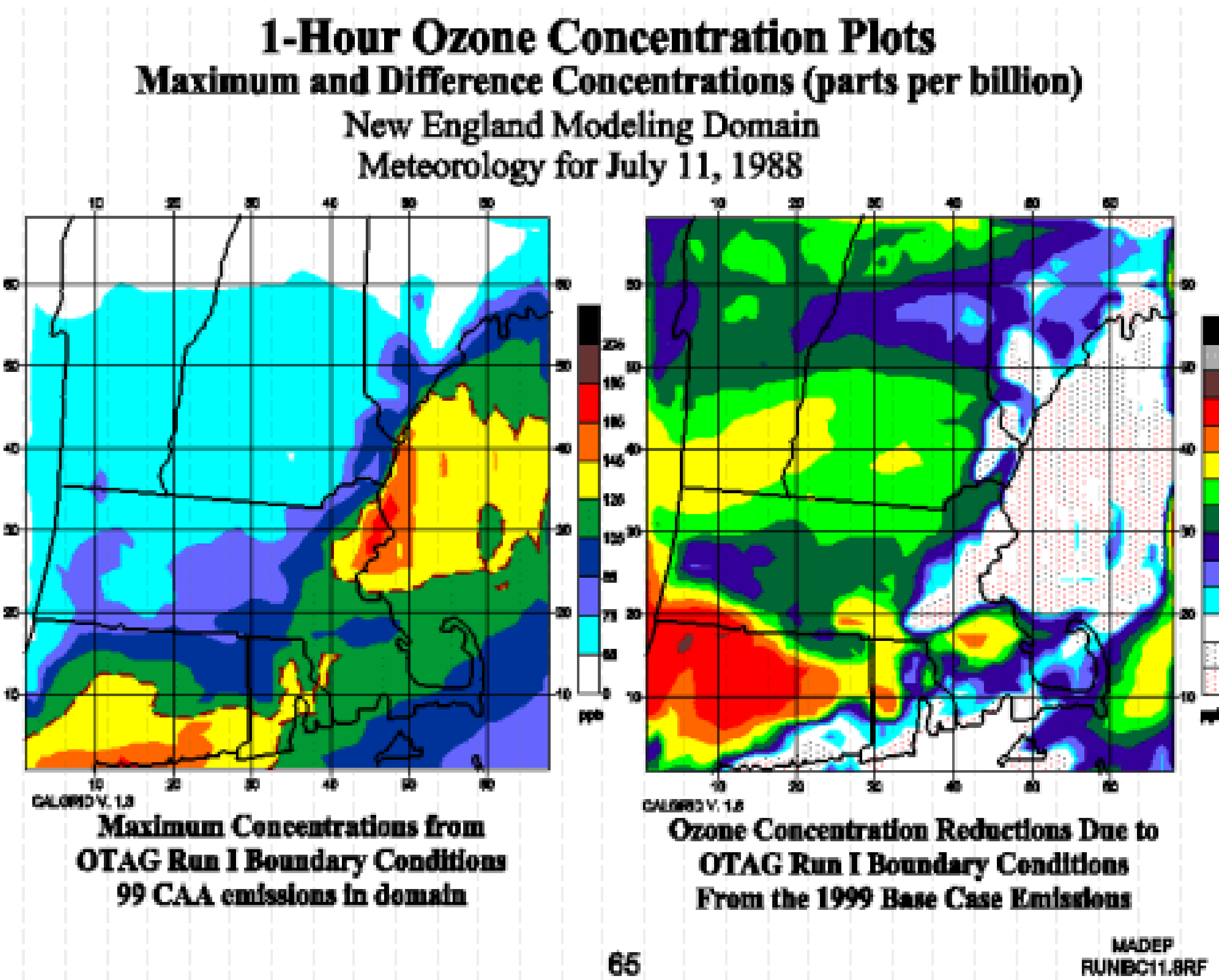


Figure 30
Maximum Plots for July 11, 1988 Episode
NOx SIP Call Emissions in Upwind Areas,
Domain: Top - CAA Emissions, Left - NOx SIP Call Emissions, and
Right - No Anthropogenic Emissions in Domain

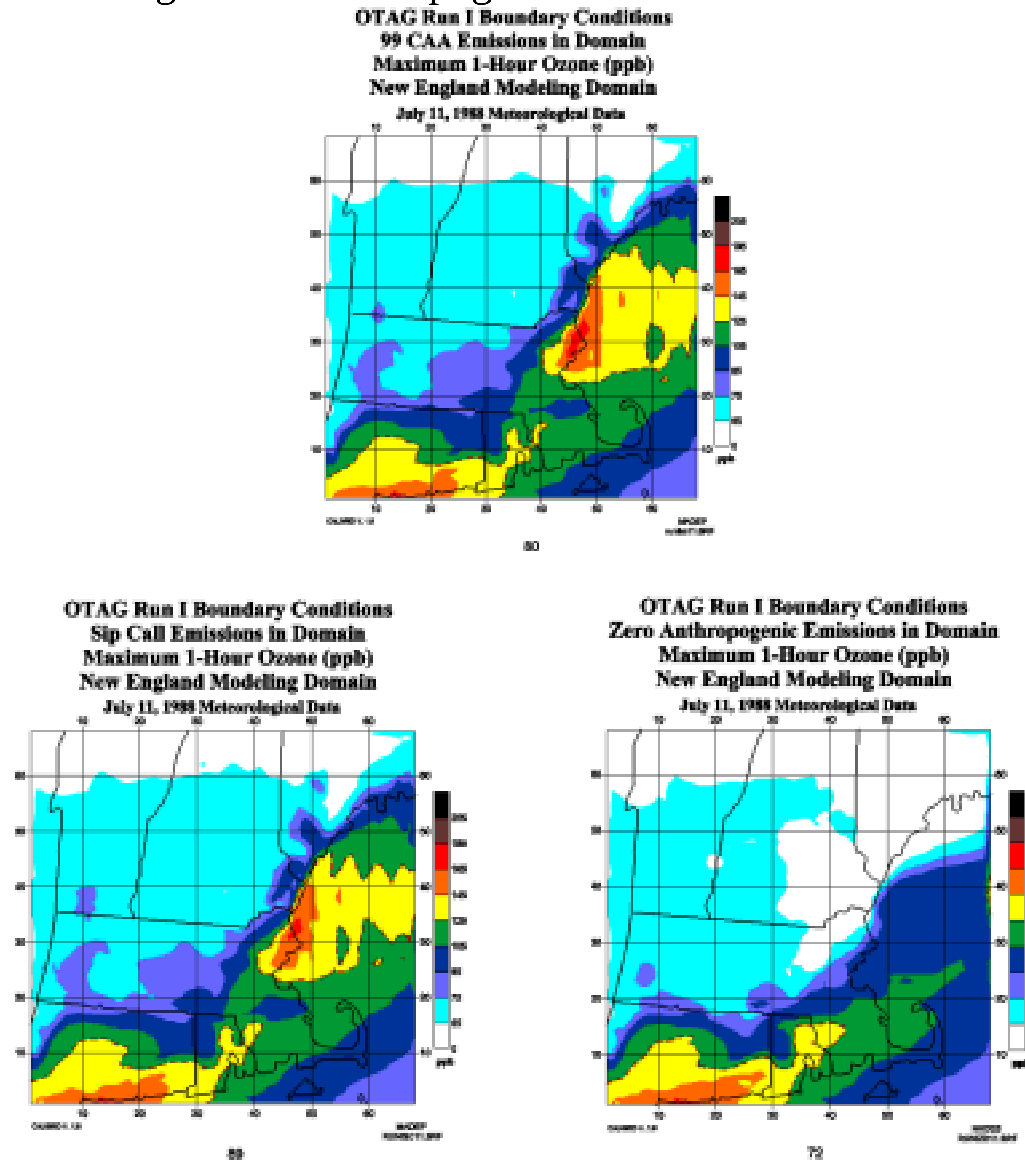


Figure 31
Percent Contribution of Source States' Emissions to Rhode Island Anthropogenic Ozone

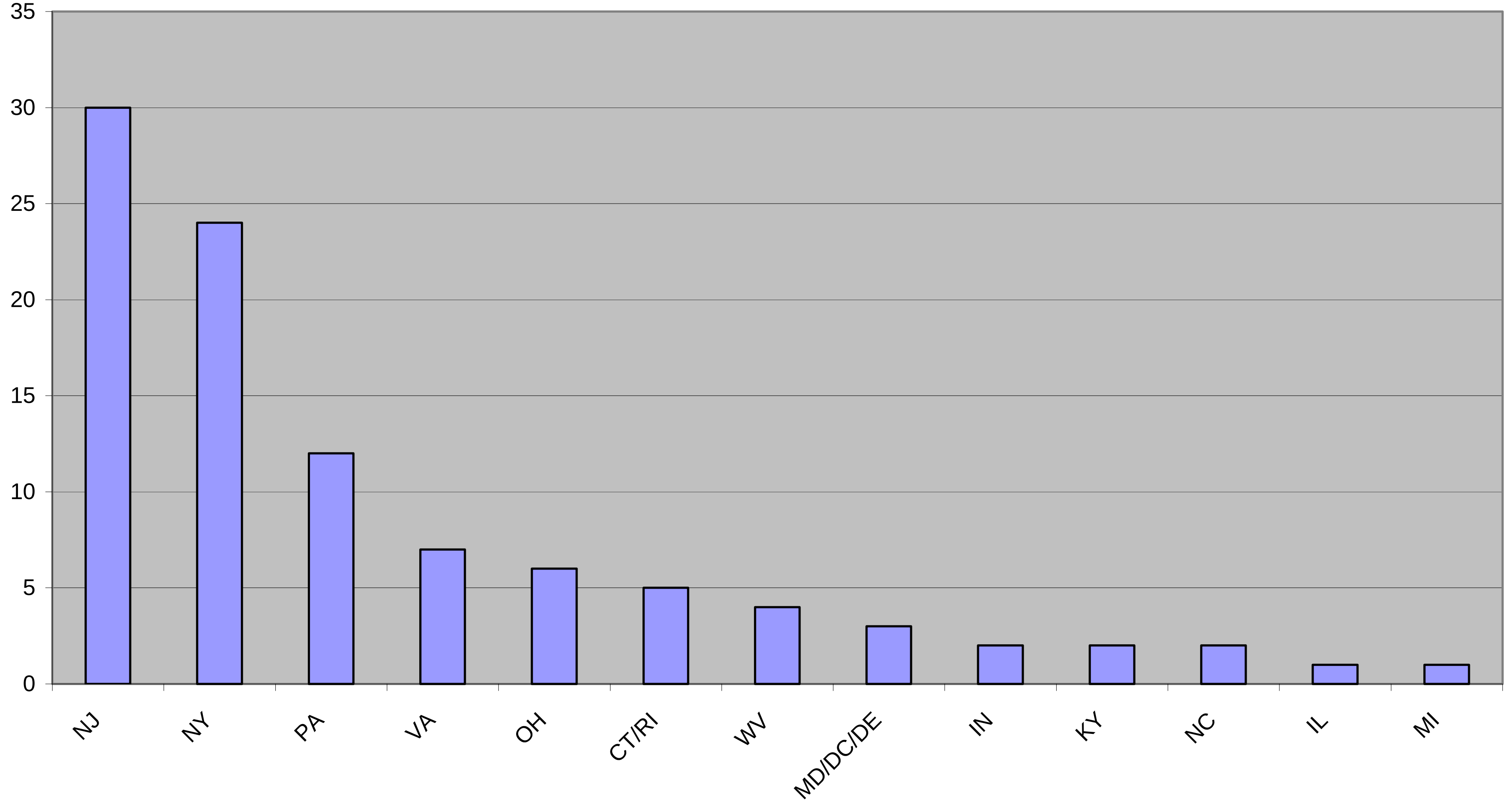


Figure 32
Ozone Exceedances at the West Greenwich, Rhode Island Monitor

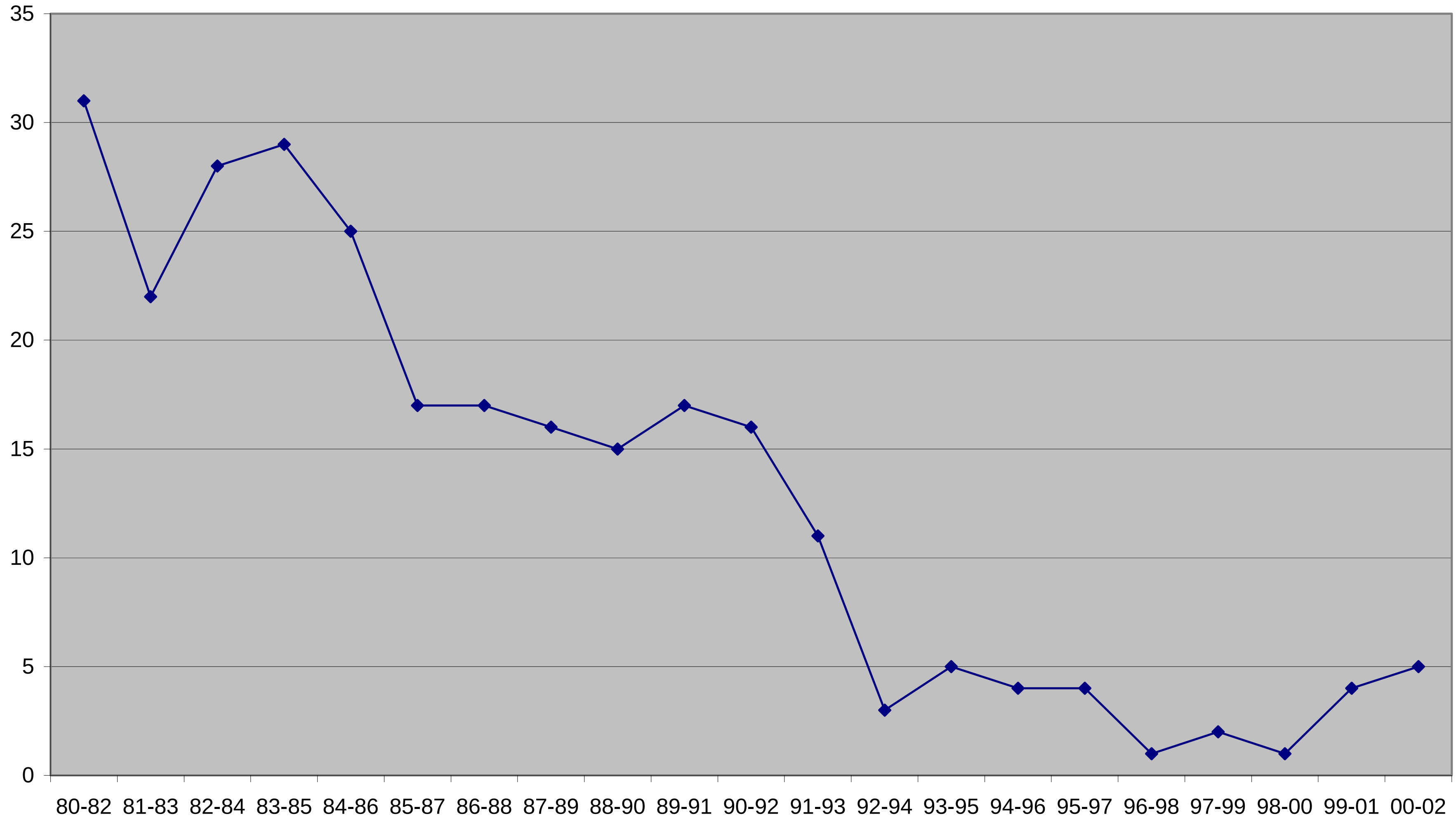


Figure 33
Design Value Trends in Rhode Island

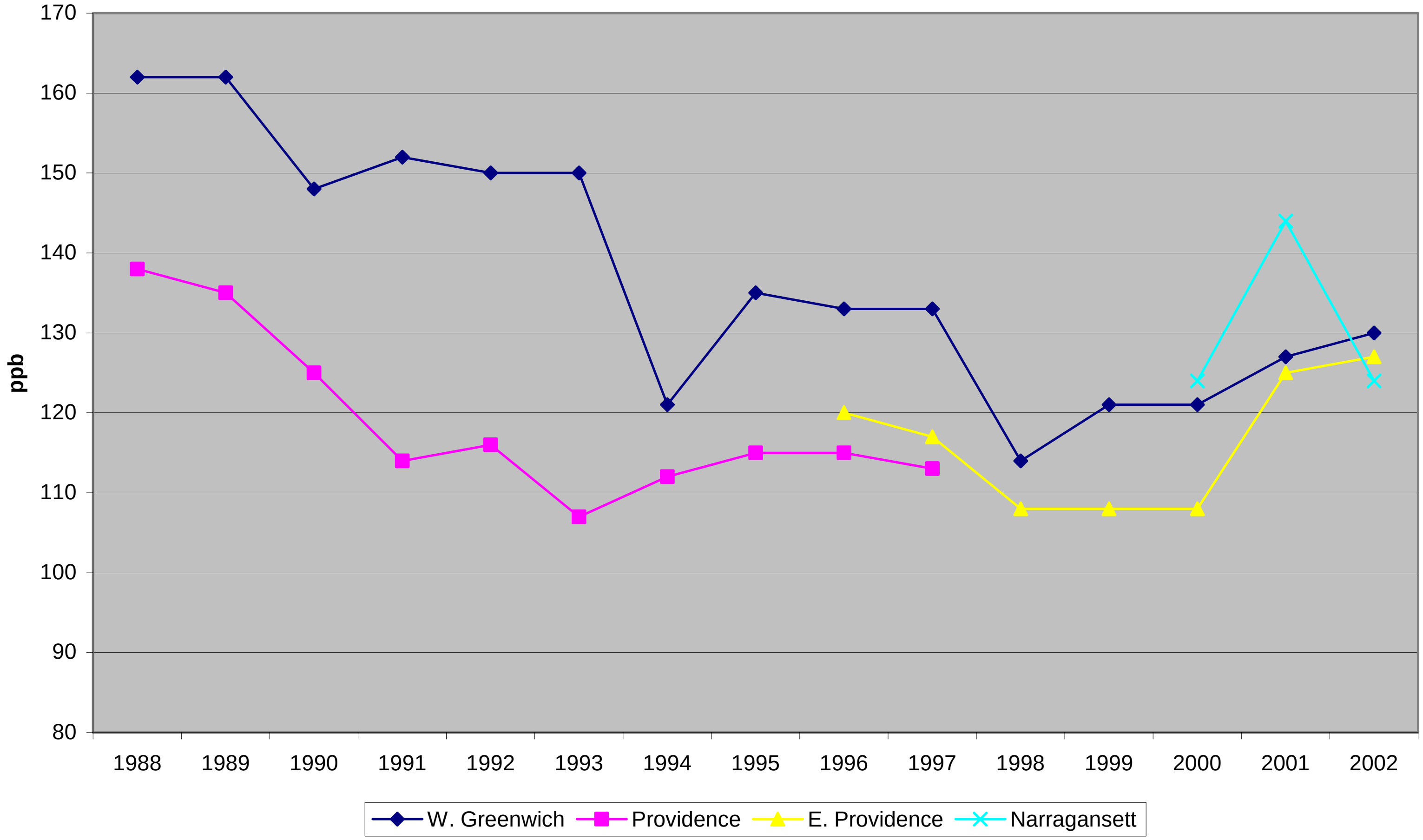
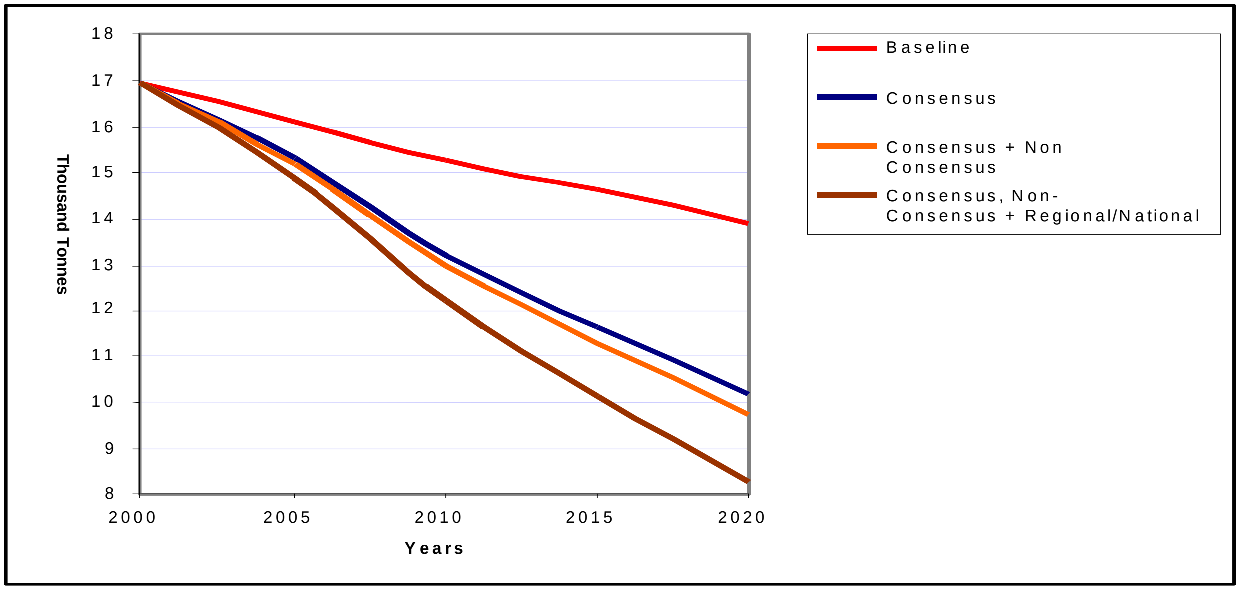
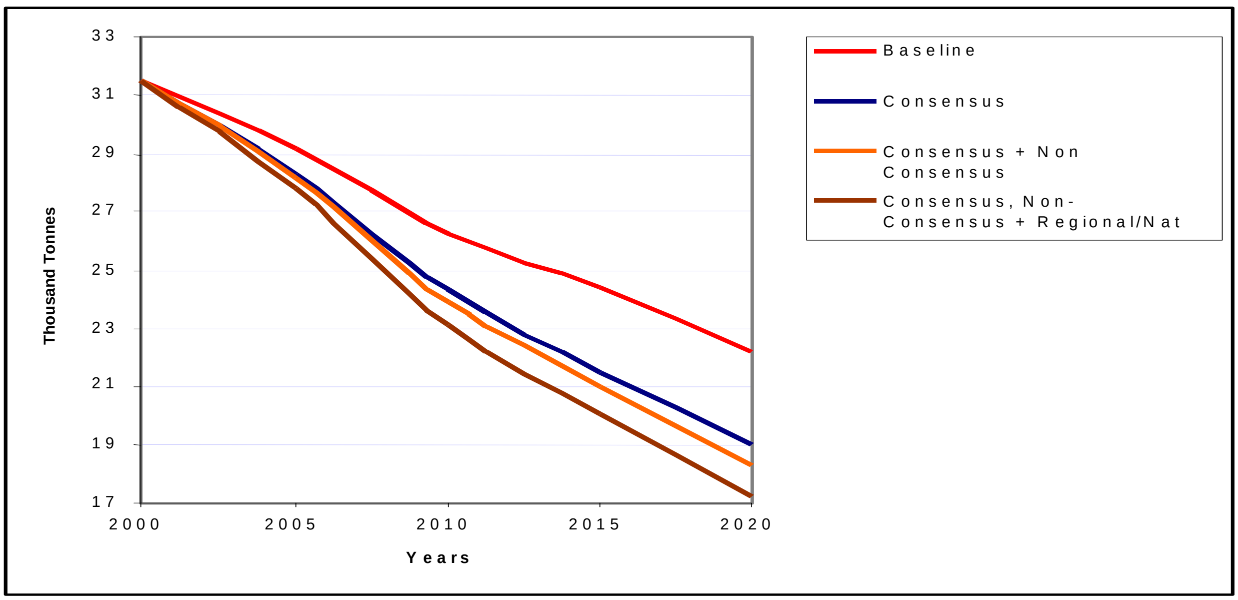


Figure 34
Estimated Impact of Implementation of Greenhouse Gas Plan Options
On NOx (top) and VOC (bottom) Emissions in Rhode Island





APPENDIX A

Rhode Island Emissions Inventory

I. Stationary Point Source Inventory

Point sources are stationary source of air pollution, primarily manufacturing facilities and power plants, that emit more than 10 tons per year of VOC or 25 tons per year of NOx. 1999 stationary point source summer day emissions were calculated for each pollutant-emitting process at each applicable facility using information provided by those facilities as part of RI DEM's annual air emissions inventory. 2002 and 2007 emissions were estimated by multiplying the 1999 emissions for each process by the growth factors for that process, as identified by Standard Industrial Classification Code (SCC), from EPA's Economic Growth and Analysis System (EGAS) model, which uses growth factors from the Federal Bureau of Labor Statistics (BLS). Projections were corrected to account for emissions caps currently in effect that would limit future emissions at applicable sources and to account for facilities that have gone out of business since 1999. These calculations for VOC and NOx emissions are shown in Tables A-1 and A-2, respectively.

Note that the 2007 inventory includes 680 pounds per summer day of NOx emissions for Rhode Island State Energy Partners, a gas fired turbine power plant that began operation in the fall of 2002. Emissions from this source, which correspond to 52 tons of NOx emissions per ozone season, would constitute only 0.4% of the total 2007 NOx inventory. This small increase in the point source NOx emissions inventory will not interfere with the timely achievement of attainment, particularly since total NOx emissions from all sources are expected to decline by 18% in the 2002-2007 period, as shown in Table 5, above.

Table A-1

Rhode Island VOC Point Source Emission Inventory in Pounds per Summer Day (ppsd)

Facility Name	City	SCC	Emission Process Description	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
ALBIN MANUF. INC.	PORTSMOUTH	31401501	BOAT BLDG	165	1.1279	1.3488	186	223
ALBIN MANUF. INC.	PORTSMOUTH	31401553	BOAT BLDG – ASSEMBLY	22	1.1279	1.3488	25	30
ALBIN MANUF. INC.	PORTSMOUTH	31401560	BOAT BLDG – CLEANUP	9	1.1279	1.3488	10	12
ALGONQUIN GAS	BURRILLVILLE	20300201	C1-RECIP. NAT GAS	0.9	1.0118	1.0453	0.9	0.9
ALGONQUIN GAS	BURRILLVILLE	20300201	C2-RECIP. NAT GAS	0.9	1.0118	1.0453	0.9	0.9
ALGONQUIN GAS	BURRILLVILLE	20300201	C3-RECIP. NAT GAS	1	1.0118	1.0453	1	1
ALGONQUIN GAS	BURRILLVILLE	28888801	MISC FUGITIVE - INT. COMB.	38	1.0000	1.0000	38	38
AMER INSULATED WIRE	PAWTUCKET	40200101	PAINTING	85	1.1492	1.3601	98	116
AMER INSULATED WIRE	PAWTUCKET	40202201	PLASTIC PARTS COATING	10	1.1364	1.3238	11	13
AMTROL, INC	W. WARWICK	40202501	METAL COATING	180	1.2944	1.7628	233	317
AMTROL, INC	W. WARWICK	40202505	METAL COATING- CLNG	0.6	1.2944	1.7628	0.7	1
ARKWRIGHT, INC.	FISKEVILLE	40201301	PAPER COATING	1805	1.0365	1.1095	1871	2003
ARKWRIGHT, INC.	FISKEVILLE	40201304	COATING STORAGE	3	1.0365	1.1095	3	3
ARKWRIGHT, INC.	FISKEVILLE	40201399	PAPER COATING	4	1.0365	1.1095	4	4
ARLON	E PROVIDNCE	40200701	SURFACE CTNG- ADHSVES	66	1.1492	1.3601	76	90
ASHAWAY LINE & TWINE	ASHAWAY	40201101	FABRIC COATING	107	1.0340	1.0170	111	109
ASHAWAY LINE & TWINE	ASHAWAY	40201105	FABRIC COATING- CLEANUP	2	1.0340	1.0170	2	2
B & D PLASTICS, INC.	JOHNSTON	40202201	PLASTIC PARTS COATING	313	1.1364	1.3238	356	414
BICCGENERAL	LINCOLN	30102601	RUBBER COMPOUNDING	84	1.1250	1.1250	95	95
BICCGENERAL	LINCOLN	40200101	PAINTING	12	1.1492	1.3601	14	16
BICCGENERAL	LINCOLN	40202505	METAL COATING- CLEANING	2	1.2944	1.7628	3	4
BLOCK ISLAND POWER	NEW SHREHM	40100305	COLD CLEANING	1	1.1862	1.4607	1	1
BLOCK ISLAND POWER	NEW SHREHM	20100101	ELEC GEN-TURBINE-DIST OIL	29	0.8546	0.7329	25	21

Facility Name	City	SCC	Emission Process Description	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
BRADFORD DYEING	WESTERLY	10200401	IND. BOILER - RESID OIL	3	1.1020	1.1777	3	4
BRADFORD DYEING	WESTERLY	40201113	FABRIC PRINTING	267	1.1014	1.1714	294	313
BRADFORD DYEING	WESTERLY	40201201	FABRIC DYEING	6	1.1014	1.1714	6	6
BRADFORD DYEING	WESTERLY	40201199	FABRIC COATING/PRINTING	26	1.0000	1.0000	26	26
BRANCH RVR FOAM PLS	SMITHFIELD	30101817	PLASTICS PRODUCTION	145	1.1250	1.1250	163	163
BROOKWOOD LAMNTNG	PEACEDALE	40201101	FABRIC COATING	68	1.0340	1.0170	70	69
BROWN UNIVERSITY	PROVIDENCE	31503101	LABORATORY PROCESS	42	1.6586	1.2035	70	51
CCL CUSTOM MFG.	CUMBERLAND	30100901	CLEANING CHEMS.	1081	1.0154	1.0769	1098	1164
CCL CUSTOM MFG.	CUMBERLAND	30183001	CHEM. STORAGE/TRANSFER	1	1.0592	1.1316	1	1
CHARBERT	WAKEFIELD	10200502	IND. BOILER - DIST. OIL	0.5	1.0477	1.1315	0.5	0.6
CHARBERT	WAKEFIELD	40201201	FABRIC DYEING	104	1.1014	1.1714	115	122
CLARIANT CORP.	COVENTRY	30112199	ORGANIC CHEMICAL MFG	123	1.0592	1.1316	130	139
CLARIANT CORP.	COVENTRY	30182002	WASTE WATER TREATMENT	48	1.0592	1.1316	51	54
CLARIANT CORP.	COVENTRY	30183001	CHEM. STORAGE/TRANSFER	1	1.0592	1.1316	1	1
COATS AMER. (clsd 6/00)	BRISTOL	40201002	COATING OVEN HEATER	205			0	0
COOLEY, INC.	PAWTUCKET	30801002	PLASTIC-EXTRUSION	40	1.1364	1.3238	45	53
COOLEY, INC.	PAWTUCKET	40201101	FABRIC COATING	584	1.0340	1.0170	604	594
COOLEY, INC.	PAWTUCKET	40201105	FABRIC COATING- CLEANUP	1	1.0340	1.0170	1	1
COOLEY, INC.	PAWTUCKET	40201113	FABRIC PRINTING	77	1.1014	1.1714	85	90
CRANSTON WCF	CRANSTON	50100701	WASTE WATER TRTMNT FAC.	54	1.0651	1.1521	58	62
CRANSTON WCF	CRANSTON	50200515	INCINERATION	137	1.0762	1.1913	147	163
CREATIVE GAMES	N. SMITHFIELD	40201399	PAPER COATING	216	1.0365	1.1095	224	0
D'AMBRA CONST.	WARWICK	30500205	ASPHALT PLANT	2	1.0000	1.0000	2	2
D'AMBRA CONST.	WARWICK	30500205	SOIL REMEDIATION/TRTMNT	55	1.0000	1.0000	55	55
DARLINGTON FABRICS	WESTERLY	10200401	IND. BOILER - RESID OIL	0.6	1.1020	1.1777	0.7	0.7
DARLINGTON FABRICS	WESTERLY	10200602	IND. BOILER - NAT. GAS	1	0.9931	1.0145	1	1
DEWAL INDUSTRIES	NARRAGNSTT	30801003	FILM PRODUCTION	72	1.1364	1.3238	82	95
DEWAL INDUSTRIES	NARRAGNSTT	40202201	PLASTIC PARTS COATING	284	1.1364	1.3238	323	376

Facility Name	City	SCC	Emission Process Description	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
DEWAL INDUSTRIES	NARRAGNSTT	40202205	PLAST. PARTS EQUIP CLNG	8	1.1364	1.3238	9	11
DISPLAY WORLD	WARREN	40202199	WOOD COATING	74	1.2106	1.5264	90	113
DORADO PRC (clsd 6/01)	WOONSOCKET	10200401	IND. BOILER - RESID OIL	1	1.1020	1.1777	0	0
DORADO PRC (clsd 6/01)	WOONSOCKET	10200602	IND. BOILER - NAT. GAS	2	0.9931	1.0145	0	0
DORADO PRC (clsd 6/01)	WOONSOCKET	39000689	PROCESS FUEL-NAT GAS	1	0.9931	1.0145	0	0
DORADO PRC (clsd 6/01)	WOONSOCKET	40201199	FABRIC COATING/PRINTING	7	1.1014	1.1714	0	0
DORADO PRC (clsd 6/01)	WOONSOCKET	40201201	FABRIC DYEING	150	1.1014	1.1714	0	0
E PROVIDENCE WWTF	E PROVIDNCE	50100701	WASTE WATER TRTMNT FAC.	55	1.0651	1.1521	59	63
EASTRN BUTCHR BLCK	PROVIDENCE	40202199	WOOD COATING	105	1.2106	1.5264	127	160
ELECTRIC BOAT	N KINGSTOWN	39001089	LPG PROCESS FUEL	0.7	1.0397	1.0844	0.7	0.8
ELECTRIC BOAT	N KINGSTOWN	40200101	PAINTING	107	1.1492	1.3601	123	146
ELECTRIC BOAT	N KINGSTOWN	40200710	SURFACE CTG-ADHESIVES	34	1.1492	1.3601	39	46
ELIZABTH WBG (clsd 01)	CENTRL FLLS	10200602	IND. BOILER - NAT. GAS	2	0.9931	1.0145	0	0
ELIZABTH WBG (clsd 01)	CENTRL FLLS	40201199	FABRIC COATING/PRINTING	128	1.1014	1.1714	0	0
FACILE HLDGS (clsd 7/01)	RUMFORD	40201301	PAPER COATING	325	1.0365	1.1095	0	0
FIBERGLASS FABRICTRS	SMITHFIELD	31401501	BOAT BLDG	38	1.1279	1.3488	43	51
FOAM TECHNOLOGY	LINCOLN	30801005	FOAM PRODUCTION	288	1.1364	1.3238	327	381
FOAM TECHNOLOGY	LINCOLN	30801005	FOAM PRODUCTION	12	1.1364	1.3238	14	16
GETTY	E PROVIDNCE	40400153	BULK TERMINAL-VAPOR CTRL	412	1.0000	1.0000	412	412
GUILD MUSIC (clsd 12/01)	WESTERLY	40202199	WOOD COATING	157	1.2106	1.5264	0	0
HERRICK & WHITE	CUMBERLAND	40202199	FLATWOOD COATING	98	1.3149	1.6580	129	162
HOMESTEAD BAKERY	E PROVIDNCE	30200301	BAKERY	101	1.0555	1.1667	107	118
INVENSYS THERML SYS	PAWTUCKET	39999997	MISC. INDUS. PROCESS	350	1.1936	1.4666	418	513
JAY PACKAGING	WARWICK	40201301	PAPER COATING	2	1.0365	1.1095	2	3
JAY PACKAGING	WARWICK	40201330	PAPER PRINTING	102	1.0365	1.1095	106	113
KENYON INDUSTRIES	KENYON	10200401	IND. BOILER - RESID OIL	1	1.1020	1.1777	1	1
KENYON INDUSTRIES	KENYON	39001089	LPG PROCESS FUEL	2	1.0397	1.0844	2	2
KENYON INDUSTRIES	KENYON	40201101	FABRIC COATING	468	1.0340	1.0170	484	476

Facility Name	City	SCC	Emission Process Description	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
KENYON INDUSTRIES	KENYON	40201111	FABRIC PRINTING	375	1.1014	1.1714	413	439
KENYON INDUSTRIES	KENYON	40201199	FABRIC COATING/PRINTING	299	1.1014	1.1714	329	350
KENYON INDUSTRIES	KENYON	40202205	PLAST. PTS EQUIP CLNG	6	1.1364	1.3238	7	8
LEVITON MFG. CO., INC.	WARWICK	30903007	FAB. METALS	149	1.1958	1.5043	178	224
METALS RECYCLING	JOHNSTON	20200401	LARGE DIESEL ENGINE	10	1.0477	1.1315	10	11
MOBIL	RIVERSIDE	40400150	TANK TRUCK LOADING	1018	1.0000	1.0000	1018	1018
MOBIL	RIVERSIDE	40400151	VALVES//SEALS/FLANGES	6	1.0000	1.0000	6	6
MOBIL	RIVERSIDE	40400179	BULK STORAGE TANK	57	1.0000	1.0000	57	57
MOBIL	RIVERSIDE	40400199	OIL STORAGE TANK	26	1.0000	1.0000	26	26
MOBIL	RIVERSIDE	50410405	AIR STRIPPING	15	1.0651	1.1521	16	17
MONARCH INDUSTRIES	E PROVIDNCE	40201901	WOOD COATING	304	1.2331	1.4172	375	431
MOTIVA ENTERPRISES	PROVIDENCE	40400150	TANK TRUCK LOADING	1908	1.0000	1.0000	1908	1908
MOTIVA ENTERPRISES	PROVIDENCE	40400151	VALVES//SEALS/FLANGES	5	1.0000	1.0000	5	5
MOTIVA ENTERPRISES	PROVIDENCE	40400179	BULK STORAGE TANK	180	1.0000	1.0000	180	180
MOTIVA ENTERPRISES	PROVIDENCE	40400199	OIL STORAGE TANKS	23	1.0000	1.0000	23	23
NARRAGNSTT BAY COM	PROVIDENCE	50100701	WASTE WATER TRTMNT FAC.	32	1.0651	1.1521	34	37
NARRAGNSTT BAY COM	PROVIDENCE	50200515	INCINERATION	35	1.0762	1.1913	38	42
NAVAL STATION	NEWPORT	10300602	COM./INST. BOILER-NAT GAS	5	1.0118	1.0453	5	6
NAVAL STATION	NEWPORT	20100101	ELEC GEN-TURBINE-DIST OIL	1	0.8546	0.7329	0.9	0.7
NAVAL STATION	NEWPORT	40202501	METAL COATING	3	1.2944	1.7628	4	5
NAVAL STATION	NEWPORT	40600499	MOTOR VECHILE REFUELING	12	1.0121	1.0278	12	13
NEW ENG. PAPER TUBE	PAWTUCKET	40201301	PAPER COATING	123	1.0365	1.1095	127	136
OCEAN STATE POWER	HARRISVILLE	20100201	ELE. GEN.TURBINE -NAT GAS	79	1.5553	2.4399	123	193
OCEAN STATE POWER	HARRISVILLE	40100399	COLD CLEANING	21	1.1862	1.4607	25	31
ORIG BRADFORD SOAP	W WARWICK	30100999	CLEANING CHEMICALS	48	1.1290	1.0645	54	51
OSRAM SYLVANIA PRDS	CENTRL FLLS	10200401	IND. BOILER - RESID OIL	1	1.1020	1.1777	1	1
OSRAM SYLVANIA PRDS	CENTRL FLLS	30501411	GLASS MANUFACTURE	24	1.1501	1.3500	28	32
OSRAM SYLVANIA PRDS	CENTRL FLLS	30501416	GLASS MANUFACTURE	110	1.1501	1.3500	127	148

Facility Name	City	SCC	Emission Process Description	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
OSRAM SYLVANIA PRDS	CENTRL FLLS	39000689	PROCESS FUEL-NAT GAS	1	0.9931	1.0145	1	1
PAWTUCKT PWR ASSC	PAWTUCKET	10300602	COM./INS BOILER-NAT GAS	2	1.0118	1.0453	2	2
PAWTUCKT PWR ASSC	PAWTUCKET	20300102	COM/INS TURBINE-DIST OIL	35	0.9689	0.8776	34	31
PAWTUCKT PWR ASSC	PAWTUCKET	20300202	COM/INS TURBINE-NAT GAS	54	1.0118	1.0453	55	56
PRESTO LIFTS (clsd 02)	PAWTUCKET	40202501	METAL COATING	145	1.2944	1.7628	188	0
PROV. METALLIZING	PAWTUCKET	40100255	VAPOR DEGREASING	70	1.1862	1.4607	83	102
PROV. METALLIZING	PAWTUCKET	40200101	PAINTING	4	1.1492	1.3601	5	5
PROV. METALLIZING	PAWTUCKET	40202201	PLASTIC PARTS COATING	127	1.1364	1.3238	144	168
PROV. METALLIZING	PAWTUCKET	40202501	METAL COATING	55	1.2944	1.7628	71	97
QUALITY SPRAYING.	PROVIDENCE	40202501	METAL COATING	78	1.2944	1.7628	101	137
QUARTER MOON	PORTSMOUTH	31401501	BOAT BLDG	96	1.1279	1.3488	108	129
R.I. CENTRAL PWR PLT	CRANSTON	10300401	COM/INS BOILER-RESID OIL	23	1.0473	1.0807	24	25
R.I. CENTRAL PWR PLT	CRANSTON	10300601	COM/INS BOILER-NAT GAS	10	1.0118	1.0453	10	10
REXAM (closed 2002)	JOHNSTON	40201301	PAPER COATING	768	1.0365	1.1095	796	0
RHODE ISLAND HOSP.	PROVIDENCE	10300401	COM/INS BOILER-RESID OIL	23	1.0473	1.0807	24	25
RHODE ISLAND HOSP.	PROVIDENCE	31502088	LABORATORY	64	1.0452	1.1581	67	74
RI RESOURCE RCVRY	JOHNSTON	20200102	IND. RECIP. ENG.- DIST. OIL	2	1.0477	1.1315	2	2
RI RESOURCE RCVRY	JOHNSTON	50100410	LANDFILL GAS FLARES	741	1.0651	1.1521	789	854
RI TEXTILE	PAWTUCKET	40100399	COLD CLEANING	2	1.1862	1.4607	2	3
RI TEXTILE	PAWTUCKET	40188801	FUGITIVE EMISSIONS	106	1.1862	1.4607	126	155
RIDGEWOOD PROV PWR	JOHNSTON	20300802	TURBINE - LANDFILL GAS	71	1.0000	1.0000	71	71
RIDGEWOOD PROV PWR	JOHNSTON	40100399	COLD CLEANING	3	1.1862	1.4607	3	4
RIVERSIDE CLEANERS	RIVERSIDE	40100146	DRY CLEANING	99	1.0561	1.1235	105	111
RUSSELL STANLEY	SMITHFIELD	30902501	DRUM CLEANING	1882	1.1958	1.5043	2250	2831
RUSSELL STANLEY	SMITHFIELD	39000689	PROCESS FUEL-NAT GAS	0.4	0.9931	1.0145	0.4	0.4
RUSSELL STANLEY	SMITHFIELD	40202601	METAL COATING	427	1.5000	1.5000	641	641
SEVILLE DYE (clsd 5/02)	WOONSCKET	10200401	IND. BOILER - RESID OIL	1	1.1020	1.1777	0.4	0
SEVILLE DYE (clsd 5/02)	WOONSCKET	10200602	IND. BOILER - NAT. GAS	3	0.9931	1.0145	1	0

Facility Name	City	SCC	Emission Process Description	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
SEVILLE DYE (clsd 5/02)	WOONSCKET	40201199	FABRIC COATING/PRINTING	16	1.1014	1.1714	6	0
SEVILLE DYE (clsd 5/02)	WOONSCKET	40201199	FABRIC COATING/PRINTING	25	1.1014	1.1714	9	0
SEVILLE DYE (clsd 5/02)	WOONSCKET	40201201	FABRIC DYEING	7	1.1014	1.1714	3	0
SLATER DYE/SCRN PRT	PAWTUCKET	10200401	IND. BOILER - RESID OIL	0.8	1.1020	1.1777	1	1
SLATER DYE/SCRN PRT	PAWTUCKET	39000689	PROCESS FUEL-NAT GAS	2	0.9931	1.0145	2	2
SLATER DYE/SCRN PRT	PAWTUCKET	40201113	FABRIC COATING	210	1.1014	1.1714	231	246
SLATER DYE WORKS	CUMBERLAND	40201199	FABRIC COATING/PRINTING	259	1.1014	1.1714	285	303
SLATER DYE WORKS	CUMBERLAND	39000689	PROCESS FUEL-NAT GAS	1	0.9931	1.0145	1	1
ST. GOBAIN PERF. PRDS	BRISTOL	30801001	PLASTIC PRODUCTS	143	1.1364	1.3238	162	189
ST. GOBAIN PERF. PRDS	BRISTOL	39000689	PROCESS FUEL-NAT GAS	2	0.9931	1.0145	2	2
STANLEY-BOSTITCH	E GREENWCH	10200401	IND. BOILER - RESID OIL	2	1.1020	1.1777	2	2
STANLEY-BOSTITCH	E GREENWCH	40200710	SURFACE CTNG-ADHESIVES	335	1.1492	1.3601	385	456
STANLEY-BOSTITCH	E GREENWCH	40202501	METAL COATING	5	1.2944	1.7628	6	9
STANLEY-BOSTITCH	E GREENWCH	40202505	METAL COATING- CLEANING	30	1.2944	1.7628	39	53
STANLEY-BOSTITCH	E GREENWCH	40202599	METAL COATING	37	1.2944	1.7628	48	65
TECH INDUSTRIES	WOONSCKET	40202201	PLASTIC PARTS COATING	308	1.1364	1.3238	350	408
TECH INDUSTRIES	WOONSCKET	40202205	PLAST. PTS. EQUIP CLNG	44	1.1364	1.3238	50	58
TECHNICAL MATERIALS	LINCOLN	40100307	COLD CLEANING/STRIPPING	60	1.1862	1.4607	71	88
TEKNOR APEX CO.	PAWTUCKET	10200401	IND. BOILER - RESID OIL	0.6	1.1020	1.1777	0.7	0.7
TEKNOR APEX CO.	PAWTUCKET	30800699	FABRICATED PLASTICS	206	1.0667	1.1734	220	242
TEPPCO OMEGA TERM.	PROVIDENCE	30600905	FLARES	61	0.2422	0.3327	15	20
TEPPCO OMEGA TERM.	PROVIDENCE	40388801	PET. PROD. STORAGE - FUG	31	1.0000	1.0000	31	31
THE HINKLEY COMPANY	PORTSMOUTH	31401501	BOAT BLDG	140	1.1279	1.3488	158	189
TORAY PLASTICS AMER.	N KINGSTWN	10200602	IND. BOILER - NAT. GAS	12	0.9931	1.0145	12	12
TORAY PLASTICS AMER.	N KINGSTWN	30800699	FABRICATED PLASTICS	95	1.0667	1.1734	101	111
TPI INC.	WARREN	31401501	SHIP BUILDING	193	1.1279	1.3488	218	260
TPI INC.	WARREN	31401552	WOOD COATING	5	1.1279	1.3488	6	7
TPI INC.	WARREN	31401560	BOAT BLDG - CLEANUP	2	1.1279	1.3488	2	3

Facility Name	City	SCC	Emission Process Description	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
UNIVERSAL PRESS	PROVIDENCE	40500401	LITHOGRAPHIC PRINTING	152	1.0724	1.2005	163	182
UNIVERSITY OF RI	KINGSTON	40500597	MISC PRINTING	6	1.0724	1.2005	6	7
USGEN NEW ENGLAND	PROVIDENCE	10100501	ELECTRIC GEN. - DIST. OIL.	96	0.8546	0.7329	82	70
WARWICK WWTF	WARWICK	50100701	WASTE WATER TRTMNT FAC.	41	1.0651	1.1521	44	47
WOONSKT WWTF/NETCO	WOONSCKET	50100701	WASTE WATER TRTMNT FAC.	12	1.0651	1.1521	13	14
WOONSKT WWTF/NETCO	WOONSCKET	50200515	INCINERATION	44	1.0762	1.1913	47	52
XYLEM FISNISHING	WARWICK	40202199	FLATWOOD COATING	52	1.2106	1.5264	63	79
ZAMBARANO MEM. HOSP	WALLUM LAKE	10300401	COM./INST. BOILER - RES OIL	1	1.0473	1.0807	1	1
ZAMBARANO MEM. HOSP	WALLUM LAKE	20200301	IND. RECIP. ENG.- GASOLINE	19	1.0438	1.1842	20	23
ZAMBARANO MEM. HOSP	WALLUM LAKE	50200501	INCINERATION	1	1.0452	1.1581	0	0
TOTALS								
		lbs/day		22039			23191	24322
		tons/day		11.0			11.5	12.0
				{1999}			{2002}	{2007}

Table A-2

Rhode Island NOx Point Source Emission Inventory in Pounds per Summer Day (ppsd)

Facility Name	City	Emission Process Description	SCC	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
ALGONQUIN GAS	BURRILLVILLE	COM/INS RECIP ENG-NAT GAS	20300201	3	1.0118	1.0453	3	3
ALGONQUIN GAS	BURRILLVILLE	COM/INS RECIP ENG-NAT GAS	20300201	2	1.0118	1.0453	2	2
ALGONQUIN GAS	BURRILLVILLE	COM/INS RECIP ENG-NAT GAS	20300201	2	1.0118	1.0453	2	2
ALGONQUIN GAS	BURRILLVILLE	COM/INS TURBINE-NAT GAS	20300202	0.2	1.0118	1.0453	0.2	0.2
ALGONQUIN GAS	BURRILLVILLE	COM/INS TURBINE-NAT GAS	20300202	1	1.0118	1.0453	1	1
AMER INSULATED WIRE	PAWTUCKET	IND. BOILER - RESID OIL	10200401	0	1.1020	1.1777	0	0
AMER INSULATED WIRE	PAWTUCKET	PROCESS FUEL-NAT GAS	39000689	4	0.9931	1.0145	4	4
ARKWRIGHT, INC.	FISKEVILLE	IND. BOILER -DIST. OIL	10200501	5	1.0477	1.2312	5	6
ARKWRIGHT, INC.	FISKEVILLE	PROCESS FUEL-NAT GAS	39000689	85	0.9931	1.0145	84	86
ASHAWAY LINE & TWINE	ASHAWAY	IND. BOILER - NAT. GAS	10200602	3	0.9931	1.0145	3	3
BICCGENERAL	LINCOLN	IND. BOILER - RESID OIL	10200401	2	1.1020	1.1777	3	3
BLOCK ISLAND POWER	NEW SHREHM	ELEC GEN-TURBINE-DIST OIL	20100101	972	0.8546	0.7329	831	712
BRADFORD DYEING	WESTERLY	IND. BOILER - RESID OIL	10200401	835	1.1020	1.1777	920	983
BRADFORD DYEING	WESTERLY	PROCESS FUEL-NAT GAS	39000689	21	0.9931	1.0145	21	21
BROWN UNIVERSITY	PROVIDENCE	COM/INS BOILER-RESID OIL	10300401	15	1.0473	1.0807	16	16
BROWN UNIVERSITY	PROVIDENCE	COM/INS BOILER-NAT. GAS	10300602	0	1.0118	1.0453	0	0
BROWN UNIVERSITY	PROVIDENCE	COM/INS TURBINE-DIST OIL	20300102	0	0.9689	0.8776	0	0
CCL CUSTOM MFG.	CUMBERLAND	IND. BOILER - RESID OIL	10200401	76	1.1020	1.1777	84	90
CHARBERT	WAKEFIELD	IND. BOILER -DIST. OIL	10200502	52	1.0477	1.1315	54	59
CLARIANT CORP	COVENTRY	IND. BOILER - RESID OIL	10200401	202	1.1020	1.1777	223	238
CLARIANT CORP	COVENTRY	IND. BOILER - NAT. GAS	10200602	8	0.9931	1.0145	8	8
COOLEY, INC.	PAWTUCKET	PROCESS FUEL-NAT GAS	39000689	28	0.9931	1.0145	28	28
CRANSTON WCF	CRANSTON	INCINERATION	50200515	151	1.0762	1.1913	162	180

Facility Name	City	Emission Process Description	SCC	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
D'AMBRA CONST	WARWICK	ASPHALT PLANTS	30500205	14	1.0000	1.0000	14	14
DARLINGTON FABRICS	WESTERLY	IND. BOILER - RESID OIL	10200401	0	1.1020	1.1777	0	0
DARLINGTON FABRICS	WESTERLY	IND. BOILER -DIST. OIL	10200501	0	1.0477	1.2312	0	0
DARLINGTON FABRICS	WESTERLY	IND. BOILER - NAT. GAS	10200602	196	0.9931	1.0145	195	199
DORADO PRC (clsd 6/01)	WOONSCKT	IND. BOILER - RESID OIL	10200401	273	1.1020	1.1777	0	0
DORADO PRC (clsd 6/01)	WOONSCKT	PROCESS FUEL-NAT GAS	39000689	18	0.9931	1.0145	0	0
DORADO PRC (clsd 6/01)	WOONSCKT	IND. BOILER - NAT. GAS	10200602	30	0.9931	1.0145	0	0
ELECTRIC BOAT	N KINGSTWN	LPG PROCESS FUEL	39001089	10	1.0397	1.0844	10	11
ELIZABTH WBG (clsd 01)	CENTRL FLLS	IND. BOILER -DIST. OIL	10200504	0	1.0477	1.2312	0	0
ELIZABTH WBG (clsd 01)	CENTRL FLLS	IND. BOILER - NAT. GAS	10200602	33	0.9931	1.0145	0	0
ELIZABTH WBG (clsd 01)	CENTRL FLLS	PROCESS FUEL-NAT GAS	39000689	7	0.9931	1.0145	0	0
FOAM TECHNOLOGY	LINCOLN	IND. BOILER -DIST. OIL	10200504	10	1.0477	1.2312	10	12
KENYON INDUSTRIES	KENYON	IND. BOILER - RESID OIL	10200401	194	1.1020	1.1777	214	228
KENYON INDUSTRIES	KENYON	LPG PROCESS FUEL	39001089	41	1.0397	1.0844	43	44
METALS RECYCLING	JOHNSTON	LARGE DIESEL ENGINE	20200401	502	1.0477	1.1315	526	568
NARRAGNSTT BAY COM	PROVIDENCE	INCINERATION	50200515	192	1.0762	1.1913	207	229
NAVAL STATION	NEWPORT	COM/INS BOILER-DIST OIL	10300501	0	0.9689	0.8776	0	0
NAVAL STATION	NEWPORT	COM/INS BOILER-DIST OIL	10300504	22	0.9689	0.8776	21	19
NAVAL STATION	NEWPORT	COM/INS BOILER-NAT. GAS	10300602	208	1.0118	1.0453	210	217
NAVAL STATION	NEWPORT	ELEC GEN-TURBINE-DIST OIL	20100101	13	0.8546	0.7329	11	10
OCEAN STATE PWR (capped)	HARRISVILLE	ELE. GEN.TURBINE -NAT GAS	20100201	1988	1.5553	2.4399	3092	3425
ORIG BRADFORD SOAP	W WARWICK	IND. BOILER - RESID OIL	10200401	54	1.1020	1.1777	60	64
ORIG BRADFORD SOAP	W WARWICK	IND. BOILER - NAT. GAS	10200602	2	0.9931	1.0145	2	2
OSRAM SYLVANIA PRDS	CENTRL FLLS	IND. BOILER - RESID OIL	10200401	13	1.1020	1.1777	14	15
OSRAM SYLVANIA PRDS	CENTRL FLLS	GLASS MANUFACTURE	30501416	1453	1.1501	1.3500	1671	1962
OSRAM SYLVANIA PRDS	CENTRL FLLS	PROCESS FUEL-NAT GAS	39000689	77	0.9931	1.0145	76	78
PAWTUCKET PWR (capped)	PAWTUCKET	COM/INS BOILER-NAT. GAS	10300602	71	1.0118	1.0453	72	47

Facility Name	City	Emission Process Description	SCC	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
PAWTUCKET PWR (capped)	PAWTUCKET	COM/INS TURBINE-DIST OIL	20300102	413	0.9689	0.8776	400	232
PAWTUCKET PWR (capped)	PAWTUCKET	COM/INS TURBINE-NAT GAS	20300202	401	1.0118	1.0453	406	268
PROVIDENCE METALLIZING	PAWTUCKET	IND. BOILER -DIST. OIL	10200501	65	1.0477	1.2312	68	80
R.I. CENTRAL PWR PLNT	CRANSTON	COM/INS BOILER-RESID OIL	10300401	1049	1.0473	1.0807	1099	1134
R.I. CENTRAL PWR PLNT	CRANSTON	COM/INS BOILER-NAT. GAS	10300601	507	1.0118	1.0453	513	530
R.I. PORT AUTH. STEAM PLNT	N KINGSTWN	COM/INS BOILER-RESID OIL	10300401	0	1.0473	1.0807	0	0
REXAM (closed 2002)	JOHNSTON	IND. BOILER -DIST. OIL	10200504	5	1.0477	1.2312	5	0
REXAM (closed 2002)		PROCESS FUEL-NAT GAS	39000689	6	0.9931	1.0145	6	0
RHODE ISLAND HOSP.	PROVIDENCE	COM/INS BOILER-RESID OIL	10300401	1523	1.0473	1.0807	1595	1646
RHODE ISLAND HOSP.	PROVIDENCE	INCINERATION	50200505	6	1.0452	1.1581	6	7
RI RESOURCE RCVRY		IND. RECIP. ENG.- DIST. OIL	20200102	38	1.0477	1.1315	40	43
RI RESOURCE RCVRY	JOHNSTON	LANDFILL GAS INCINERATOR	50100411	34	1.0651	1.1521	36	39
RI ST ENRGY PRTS (RELIANT)		ELE. GEN.TURBINE -NAT GAS	20100201	0	1.5553	2.4399	0	680
RIDGEWOOD PROV PWR	JOHNSTON	TURBINE - LANDFILL GAS	20300802	316	1.0000	1.0000	316	316
RUSSELL STANLEY	SMITHFIELD	PROCESS FUEL-NAT GAS	39000689	24	0.9931	1.0145	24	24
ST. GOBAIN PERF. PRDS	BRISTOL	PROCESS FUEL-NAT GAS	39000689	14	0.9931	1.0145	14	14
SEVILLE DYE (clsd 5/02)	WOONSCKT	IND. BOILER - RESID OIL	10200401	295	1.1020	1.1777	23	0
SEVILLE DYE (clsd 5/02)	WOONSCKT	IND. BOILER - NAT. GAS	10200602	53	0.9931	1.0145	23	0
SEVILLE DYE (clsd 5/02)	WOONSCKT	PROCESS FUEL-NAT GAS	39000689	30	0.9931	1.0145	23	0
SLATER DYE WORKS	CUMBERLAND	IND. BOILER - RESID OIL	10200401	7	1.1020	1.1777	8	9
SLATER DYE WORKS	CUMBERLAND	PROCESS FUEL-NAT GAS	39000689	27	0.9931	1.0145	27	27
SLATER DYE/SCRN PRT	PAWTUCKET	IND. BOILER - RESID OIL	10200401	218	1.1020	1.1777	240	257
SLATER DYE/SCRN PRT	PAWTUCKET	PROCESS FUEL-NAT GAS	39000689	38	0.9931	1.0145	38	39
STANLEY-BOSTITCH	E GREENWCH	IND. BOILER - RESID OIL	10200401	28	1.1020	1.1777	31	33
STANLEY-BOSTITCH	E GREENWCH	PROCESS FUEL-NAT GAS	39000689	10	0.9931	1.0145	10	10
TECH INDUSTRIES, INC.	WOONSCKT	IND. BOILER -DIST. OIL	10200504	0	1.0477	1.2312	0	0
TECH INDUSTRIES, INC.	WOONSCKT	PROCESS FUEL-NAT GAS	39000689	9	0.9931	1.0145	9	9

Facility Name	City	Emission Process Description	SCC	1999 Emissions (ppsd)	Growth 1999-2002	Growth 1999-2007	2002 Emissions (ppsd)	2007 Emissions (ppsd)
TEKNOR APEX CO.	PAWTUCKET	IND. BOILER - RESID OIL	10200401	163	1.1020	1.1777	180	192
TEKNOR APEX CO.	PAWTUCKET	IND. BOILER - NAT. GAS	10200602	3	0.9931	1.0145	3	3
TEPPCO OMEGA TERMINAL	PROVIDENCE	IND. BOILER - NAT. GAS	10200602	22	0.9931	1.0145	22	22
TEPPCO OMEGA TERMINAL	PROVIDENCE	FLARES	20190099	29	0.9928	0.9108	29	26
TIVERTON POWER	TIVERTON	ELE. GEN.TURBINE –NAT GAS	20100201	0	1.5553	2.4399	295	463
TORAY PLASTICS AMERICA	N KINGSTWN	IND. BOILER - NAT. GAS	10200602	42	0.9931	1.0145	42	43
TORAY PLASTICS AMERICA	N KINGSTWN	FABRICATED PLASTICS	30800699	74	1.0667	1.1734	79	87
TORAY PLASTICS AMERICA	N KINGSTWN	PROCESS FUEL-NAT GAS	39000689	3	0.9931	1.0145	3	3
TPI INC.	WARREN	PROCESS FUEL-NAT GAS	39000689	1	0.9931	1.0145	0	1
UNIVERSITY OF RI	KINGSTON	COM/INS BOILER-RESID OIL	10300401	0	1.0473	1.0807	0	0
UNIVERSITY OF RI	KINGSTON	COM/INS BOILER-NAT. GAS	10300602	0	1.0118	1.0453	0	0
UNIVERSITY OF RI	KINGSTON	COM/INS BOILER-NAT. GAS	10300602	9	1.0118	1.0453	9	9
USGEN NEW ENGLAND INC.	PROVIDENCE	ELECTRIC GEN. - DIST. OIL.	10100501	2111	0.8546	0.7329	1804	1547
WOONSCKT WWTF/NETCO	WOONSOCKET	COM/INS BOILER-DIST OIL	10300501	2	0.9689	0.8776	2	2
WOONSCKT WWTF/NETCO	WOONSOCKET	INCINERATION	50200515	294	1.0762	1.1913	316	350
ZAMBARANO MEM. HOSP	WALLUM LAKE	COM/INS BOILER-RESID OIL	10300401	40	1.0473	1.0807	42	43
ZAMBARANO MEM. HOSP	WALLUM LAKE	IND. RECIP. ENG.- GASOLINE	20200301	257	1.0570	1.1842	1	1
ZAMBARANO MEM. HOSP	WALLUM LAKE	INCINERATION	50200501	6	1.0774	1.1581	0	0
TOTALS								
			lb/day	16061			16690	17780
			tons/day	8.0			8.3	8.9
				1999			2002	2007

II. Stationary Area Source Inventory

Area sources are smaller stationary sources, including small surface coaters, dry cleaners, small boilers and the use of consumer products. Area sources are too small to be accounted for individually, but, taken in the aggregate, may emit a substantial amount of pollutants. 1999 stationary area source emissions were calculated as follows:

- Gasoline distribution emissions were calculated by applying emissions factors from EPA's AP-42 document to the number of gallons of taxable and nontaxable gasoline sold in Rhode Island in 1999, data which were obtained from RI Division of Taxation. Note that area source gasoline distribution emissions do not include Stage II refueling emissions. Stage II emissions were included in the on-road mobile category.
- Architectural coatings emissions were calculated using a method identified in EPA's Emission Inventory Improvement Plan (EIIP). The method apportions national sales of paint to Rhode Island based on population and then utilizes EPA emissions factors.
- An EIIP method was also used for automobile refinishing. National emissions were apportioned to Rhode Island based on relative population data.
- Emissions for the commercial and consumer products, graphic arts, traffic paints, small surface coating and surface cleaning categories were calculated using per capita emission factors. Emissions for these categories included in the point source inventory were subtracted where applicable.
- The use of cutback and emulsified asphalt during the summer months is prohibited in Rhode Island by RI Air Pollution Control Regulation No. 25.
- To calculate landfill emissions, the emissions for Central Landfill, which is now included in the point source inventory, were subtracted from the 1996 emissions for this source category in the Rate of Progress (ROP) analysis. The adjusted 1996 emissions were then grown to 1999 using EGAS growth factors for the applicable SCC code.
- Emissions from small source combustion were calculated using fuel use data obtained from State Energy Data Reports. Point source emissions were subtracted where applicable. It was assumed that 10% of all residential fuel except wood, 0% of residential wood, 25% of commercial and industrial natural gas and 10% of all other commercial and industrial fuels is used in the summer.
- For all other area source categories, the 1996 ROP emissions were grown to 1999 using EGAS growth factors by SCC code.

1999 emissions were then grown to 2002 and 2007 using EGAS growth factors by SCC code. VOC and NOx emissions from area sources are shown in Tables A-3 and A-4, respectively. Although Rhode Island expects to adopt additional emissions control regulations for consumer products, architectural coatings and gasoline cans before 2007 pursuant to an Ozone Transport Commission Memorandum of Understanding, those control programs have not yet been promulgated and, therefore, expected emissions reductions from those programs were not included in the inventory calculations.

Table A-3
Rhode Island VOC Stationary Area Source Emission Inventory
in Tons per Summer Day (tpsd)

		Emissions (tpsd)				EGAS Growth Projections		
Source Category	SCC Code	1996	1999	2002	2007	1996-99	1996-2002	1996-2007
Gasoline Distribution*	2501060050		4.20	4.25	4.32	1.0342	1.0467	1.0629
Dry Cleaning	2420000000	0.05	0.05	0.06	0.06	1.0854	1.1463	1.2195
Arch. Coatings	2401001000		4.20	4.31	4.43	1.0000	1.0262	1.0546
Auto Refinishing	4020160		1.09	1.31	1.53	1.1111	1.3333	1.5556
Commercial & Cons. Prod.	2460000000		10.64	11.27	12.04	1.0270	1.0878	1.1622
Small Surface Coating	24010		11.44	11.74	12.06	1.0000	1.0262	1.0546
Graphic Arts	2425000000		2.48	2.66	2.98	1.0781	1.1562	1.2943
Surface Cleaning	2415000000		8.52	10.11	12.44	1.0602	1.2576	1.5486
Cutback/Emulsified Asphalt	2461021000		0.00	0.00	0.00	1.0978	1.1814	1.3078
Pesticide	2461800000	0.58	0.57	0.54	0.51	0.9755	0.9367	0.8856
Oil Spills	49000204	0.10	0.10	0.11	0.12	1.027	1.0878	1.1622
POTWs	50100701	0.06	0.06	0.07	0.07	1.0455	1.1136	1.2045
TSDFs	2640000000	0.01	0.01	0.01	0.01	1.0455	1.1136	1.2045
Landfills	2620000000	1.76	1.84	1.96	2.12	1.0455	1.1136	1.2045
Fires	2810030000	0.23	0.23	0.23	0.23	0.9986	0.9978	0.9947
Leaking USTs	2660000000		0.13	0.14	0.15	1.0455	1.1136	1.2045
Small Source Combustion	2103004000		0.16	0.16	0.14	0.7547	0.7312	0.6623
Traffic Paints	2401008000		0.95	0.97	1.00	1.0000	1.0262	1.0546
Total Area Source VOC			46.7	49.9	54.2			

* Gasoline distribution does not include Stage II. Stage II refueling emissions are included in on-road mobile category.

Table A-4
Rhode Island NOx Stationary Area Source Emission Inventory
in Tons per Summer Day (tpsd)

		Emissions (tpsd)			EGAS Growth Projections		
Source Category	SCC Code	1999	2002	2007	1996-99	1996-2002	1996-2007
Combustion	2103004000	1.47	1.42	1.29	0.7547	0.7312	0.6623
Fires	2810030000	0.03	0.03	0.03	0.9986	0.9978	0.9947
Total Area Source NOx		1.5	1.45	1.3			

III. Non-Road Mobile Source Inventory

Non-Road sources are engines that are usually not operated on a road, such as construction equipment, boats, recreational equipment and lawnmowers. 1999, 2002 and 2007 emissions for all non-road mobile source categories except locomotives, commercial marine vessels and aircraft were estimated using EPA's NONROAD model, V.2.1. The model includes applicable state and county growth factors and takes into account projected emissions reductions from planned federal control programs such as Phase II Small Engine Standards. Equipment population data provided by RI DEM's Office of Boating and Safety were used in the model for calculating emissions from recreational boats. The output files from the NONROAD modeling runs are included in Appendix B of this document.

The NONROAD model does not calculate emissions for aircraft, commercial marine vessels and locomotives. 1999 emissions for those categories were calculated using methods specified in the EPA Mobile Source Procedure Document, Volume IV. For these calculation, RI DEM obtained 1999 landing and take-off cycle data for commercial flights at T. F. Green Airport and for smaller aircraft at all of the six Rhode Island airports, 1999 residual and distillate fuel-use data for commercial marine vessels from the DOE Energy Information Administration, and fuel consumption data from Amtrak, the P&W Railroad and the Quonset Point Industrial Park for line haul and yard locomotives. 1999 emissions for these source categories were then projected to 2002 and 2007 using EGAS growth factors by SCC code. Non-road emissions for VOC and NOx are shown in Table A-5.

Table A-5
Rhode Island Non-Road Mobile Source Emission Inventory
in Tons per Summer Day (tpsd)

		Emissions (tpsd)			EGAS Growth Projections		
Source Category	**SCC Code**	**1999**	**2002**	**2007**	**1996-99**	**1996-2002**	**1996-2007**
Non-Road VOC							
NONROAD Model categories		30.6	28.0	21.2			
Commercial Marine Vessels	2280000000	0.19	0.21	0.23	1.1510	1.2604	1.3854
Aircraft	2275000000	0.29	0.33	0.38	1.1028	1.2383	1.4393
Locomotive Engines	2285002000	0.026	0.02	0.02	0.9006	0.8223	0.6524
Total Non-road VOC		31.1	28.6	21.8			
Non-Road NOx							
NONROAD Model categories		28.1	27.7	26.1			
Commercial Marine Vessels	2280000000	1.91	2.09	2.30	1.151	1.2604	1.3854
Aircraft	2275000000	0.73	0.82	0.95	1.1028	1.2383	1.4393
Locomotive Engines	2285002000	0.613	0.56	0.44	0.9006	0.8223	0.6524
Total Non-road NOx		31.4	31.2	29.8			

IV. On-Road Mobile Source Inventory

A. Methodology

On-road mobile sources are vehicles that travel on roadways, including cars, sports utility vehicles, vans, minivans and trucks. RI DEM used EPA's MOBILE6.2 on-road emissions factor model along with Rhode Island highway and vehicle miles traveled data to calculate emissions for this source type. The Rhode Island Department of Transportation (RI DOT) supplied RI DEM with 1999 seasonally adjusted (July) average daily vehicle miles traveled (DVMT) data for each of the 12 FHWA roadway classifications. Those data are derived from the State's Highway Performance Monitoring System (HPMS) network.

One would normally apportion the DVMT for each roadway classification to the EPA vehicle classes based on the relative number of vehicles in each of the eight vehicle classes. However, EPA has provided RI DEM a vehicle fleet data analysis, comparing the VMT mix generated from Rhode Island Division of Motor Vehicle (RIDMV) registration data with the MOBILE6 default mix. The analysis indicates that it is appropriate to use Rhode Island data for heavy-duty gas vehicles and heavy-duty diesel vehicles, but that data provided by the RIDMV count some light duty gasoline trucks as light duty gasoline vehicles. The EPA analysis, which is shown in Figure A-1, provides an adjusted VMT mix for 1999, 2002 and 2007. RI DEM calculated the VMT mix for 2009 using the same method. DVMT data were projected to years 1999, 2002, 2007 and 2009 at a 2.083 percent growth rate per year, the average of the growth measured by the HPMS network over the most recent ten year period. Note that 2009 emissions were estimated only for the purpose of determining whether Rhode Island meets its contingency measure obligations, as discussed in Section VI of this document.

The modeling reflects the implementation of the State's Motor Vehicle Inspection/Maintenance program, which began operating in January 2000 and which began requiring on-board diagnostics testing for model years 1996 or newer vehicles subject to the program beginning in January 2003. The modeling also includes the implementation of the National Low Emissions Vehicles program in the State beginning with model year 1999 vehicles, the national implementation of the Federal Tier 2/Gasoline Sulfur program beginning in 2004, and the use of reformulated gasoline in the State. A more detailed description of the MOBILE6.2 modeling follows. The model input and output files are included in Appendix B.

The composite emission factor, in grams per mile, was determined by MOBILE 6.2 using the average vehicle speeds from the RI Statewide Model (RISM), as provided by the Rhode Island Statewide Planning Program. These speeds represent the roadway speeds for each of the 12 roadway classifications in Rhode Island. The reported speeds were adjusted to account for the limitations of the MOBILE6.2 model. These factors were then multiplied by the DVMT for that roadway classification and vehicle class to determine emissions in grams per day. The gram per day emissions for the 12 roadway classifications were then summed and converted to units of tons per day emissions for each pollutant. The emissions calculated in this manner, without consideration of refueling losses, are shown in Table A-6.

Table A-6
Rhode Island On-Road Mobile Source Emission Inventory Without Refueling Losses, in Tons per Summer Day (tpsd)

Pollutant	1999	2002	2007
Volatile Organic Cmpds. (VOC)	51.22	38.48	30.37
Nitrogen Oxides (NOx)	52.23	46.34	33.62

The MOBILE6 model also calculates VOC emissions from Stage II vehicle refueling operations. The model assumed that RI DEM's Stage II vapor control program, which was first implemented in 1995, achieves an average efficiency of 84% for all vehicle types. Refueling loses, as calculated by the model, are 1.06 tpsd for 1999, 0.78 tpsd for 2002 and 0.63 tpsd for 2007. The total predicted on-road emissions, including Stage II refueling losses, are shown in Table A-7.

Table A-7
Rhode Island On-Road Mobile Source Emission Inventory With Refueling Losses, in Tons per Summer Day (tpsd)

Pollutant	1999	2002	2007
Volatile Organic Cmpds. (VOC)	52.28	39.25	31.00
Nitrogen Oxides (NOx)	52.23	46.34	33.62

B. MOBILE6 Input File Description

The input file for the MOBILE6 modeling for the RI Attainment Demonstration is named RIFILE10.inp and is included in Appendix B. The following is a description of the parameters used in this file:

1. Model Period

The model was run for July of calendar years 1999, 2002, 2007 and 2009. Note that the 2009 run was used only to estimate 2007 – 2009 emissions reductions to determine whether Rhode Island meets contingency measure requirements, as discussed in Section VI of this document.

2. Vehicle Fleet Mix and Vehicle Registration Age Distribution

The EPA adjusted VMT mix values were used for each model year run as indicated in the VMT fraction command in the model input file. The MOBILE6 utility program was used to convert the eight vehicle registration age distribution to the required 16 classifications used in Mobile6.2. The files containing the vehicle age distribution fractions are named RI1999VR.prn, RI2002VR.prn, RI2007VR.prn and RI2009.prn and are included in Appendix B.

3. Motor Vehicle Inspection/Maintenance (I/M) Program

A separate input file named was created for modeling the Rhode Island I/M program. The Rhode Island I/M program, which began operating in January 2000, is a decentralized program which requires biannual testing for vehicles with Gross Vehicle Weight Ratings less than or equal to 8,500 pounds. It was assumed that the Rhode Island program is 75% as effective as a centralized program.

Two different I/M programs were modeled. For the first three years of the program all vehicles were subject to the RI2000 test procedure, which uses a dynamometer, a BAR 97 analyzer, the V-MAS emission collection system and the BAR 31 drive cycle, which correlates well with the I/M 240-test procedure. Beginning in January 2003, vehicles with model years 1996 and newer are instead receiving an on-board diagnostics test, as required by EPA. Vehicles with model years 1995 and older continue to receive the RI2000 test.

The EPA cutpoints for the RI2000 test are included in a separate file called RICUTP.d, which is included Appendix B. The I/M program's stringency was set at 20%, and the compliance rate at 96%. The waiver rate used was 3.0%. Vehicles over age 25 years and less than two years are exempt from the program. The I/M program file is named RIIM2TH.d.

4. Stage II Refueling

Rhode Island Stage II refueling vapor control program began in 1995 and was phased in over 3 years. An 84% efficiency for all vehicle types was assumed for this program

5. National Low Emissions Vehicles (NLEV) and Tier2 Programs

Rhode Island implemented the NLEV program for light duty gas vehicles beginning with model year 1999. The modeling assumes that Rhode Island will experience benefits from the EPA's Tier 2 tailpipe standard starting in year 2004. These programs were modeled using an input file called NLEVNE.d. This file was created with the assistance of EPA's Office of Transportation and Air Quality in Ann Arbor, MI and the EPA New England Regional Office and is included in Appendix B.

6. Meteorological Inputs

The minimum and maximum daily temperatures were set to 67 and 88^{o}F, respectively. The default value of 75 grains per pound for absolute humidity was used as per recommendation by the EPA New England Regional Office.

7. Fuel Inputs

Reformulated gasoline (RFG) is sold in Rhode Island year round and is therefore used throughout the ozone season. As such, the fuel program command was set to “2” for RFG and “N” for northern US region. Based on the recommendation of the EPA New England Regional Office, the fuel Reid Vapor Pressure (RVP) command was set to 6.8 psi to reflect the anticipated RVP for RFG sold in 2007.

8. Model Output

The results of the model provided emission rates for 12 roadway classes. The output file created was named RIFILE12.out. That file, along with all input files, is included in Appendix B.

C. Emission Calculations

The emissions generated from the MOBILE6.2 model were used to calculate typical summer day on-road emissions of VOC, NOx and CO. These calculations are shown in the file Calculations 2007.xls, which is included in Appendix B.

Figure A –1 Rhode Island VMT Mix Analysis for Draft 1 Hr O3 SIP, December, 2002									
Part I: Comparison of RI 2000 VMT Mix and MOBILE 6 default VMT mix									
Chart 1: 2000 VMT mix used by Rhode Island in Aug 02 TIP									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	Sum
2000*	0.814	0.096	0.027	0.027	0.001	0.001	0.009	0.025	1.0
* Obtained from DMV report for 2000 via the Rhode Island Air Quality Conformity Analysis dated August, 2000;									
LDDV adjusted from .000 to .001 and LDGV adjusted from 0.815 to 0.814									
Chart 2: Default MOBILE 6 VMT mix for 2000									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	Sum
2000	0.4841	0.2894	0.0996	0.0359	0.0011	0.0016	0.0820	0.0063	1.0
Chart 3: Difference between Default MOBILE 6 VMT mix for 2000 and RI VMT mix									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	Sum
2000	-0.3299	0.1934	0.0726	**0.0089**	0.0001	0.0006	**0.0730**	-0.0187	0.0
Using MOBILE 6 default values results in a significant increase in the fraction of HDGV and HDDV vehicles (i.e., the bolded items above).									
RI DMV data should be more accurate for these vehicle types and adjustment of the RI data for these vehicles is not appropriate.									

Part II: Adjusted Rhode Island 2000 VMT Mix based on 2000 Registration Data

Chart 4: Rhode Island State Motor-Vehicle Registrations in 2000 (from FHWA-Highway Statistics)

Cars	538,975		**Pickups**	88,046
			Vans	52,568
			Other light trucks	1,240
LDGV	538,975		**LDGT**	141,854
In RI registration data, the ratio of LDGV vehicles to LDGT1-4 =	3.8	to	1	
In RI VMT mix, the ratio of LDGV VMT mix to LDGT1&2 VMT mix =	6.6	to	1	
In MOBILE 6 default VMT mix, the ratio of LDGV VMT mix to LDGT1&2 VMT mix =	1.2	to	1	

Indicates that some light duty gasoline trucks (LDGT) are being counted as light duty gasoline vehicles (LDGV) in the RI VMT mix fractions.

Chart 5: MOBILE6 defaults average mileage accumulation rates for different vehicle types

Type / Year		
LDGV	10,545.6	miles per year
LDGT1 & 2	12,503.8	miles per year
LDGT3 & 4	12,197.9	miles per year

(See mileage accumulation worksheet for the calculation of these values.)

Average mileage accumulation LDGT1-4 =	12,350.9	miles per year

Chart 6: Adjusted ratio of LDGV VMT mix to LDGT1&2 VMT mix =									
	RI Vehicles from registration data	**Mileage accumulation for vehicle type**	**Total miles for vehicle type**	**VMT fraction of total LDGV and LDGT VMT**					
LDGV	538,975	10,545.6	5,683,812,119	0.764					
LDGT	141,854	12,350.9	1,752,020,696	0.236					
Adjusted RI ratio of LDGV VMT mix to LDGT1&2 VMT mix =	3.2	to	1.0						
Chart 7: Adjusted Rhode Island 2000 VMT Mix for LDGV and LDGT based on adjusted ratio									
	LDGV	**LDGT1**	**LDGT2**	**SUM of LDGV & LDGT fraction**					
RI VMT mix for 2000	0.814	0.096	0.027	0.937					
Reproportioned RI 2000 VMT mix based on adjusted ratio of LGGV to LDGT	0.716	0.172	0.048	0.937					
Chart 8: Adjusted Rhode Island 2000 VMT Mix for all categories									
	LDGV	**LDGT1**	**LDGT2**	**HDGV**	**LDDV**	**LDDT**	**HDDV**	**MC**	**Sum**
2000	0.716	0.172	0.048	0.027	0.001	0.001	0.009	0.025	1.0

Part III: Changes in default MOBILE 6 VMT mix from 2000 time period									
Chart 9: MOBILE 6 VMT mix used by Rhode Island in Dec 02 draft SIP (same as MOBILE 6 defaults)									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	total
1999 VMT mix	0.5033	0.2749	0.0947	0.0360	0.0014	0.0018	0.0815	0.0064	1.0
2002 VMT mix	0.4568	0.3091	0.1063	0.0360	0.0008	0.0017	0.0833	0.0060	1.0
2007 VMT mix	0.3872	0.3600	0.1237	0.0359	0.0004	0.0019	0.0854	0.0056	1.0
Chart 10: Changes in default MOBILE 6 VMT mix from 2000 time period in Chart 2									
Change from 2000 to 1999	-0.0192	0.0145	0.0049	-0.0001	-0.0003	-0.0002	0.0005	-0.0001	0.0
Change from 2000 to 2002	0.0273	-0.0197	-0.0067	-0.0001	0.0003	-0.0001	-0.0013	0.0003	0.0
Change from 2000 to 2007	0.0969	-0.0706	-0.0241	0.0000	0.0007	-0.0003	-0.0034	0.0007	0.0
(negative numbers indicate an increase)									
Part IV: Changes in Rhode Island VMT Mix based on MOBILE 6 Default Values									
Chart 11: Adjusted Rhode Island VMT mix based on changes over time from default MOBILE 6 VMT mixes									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	total
Adjusted Rhode Island VMT mix for 1999	0.7354	0.1578	0.0436	0.0271	0.0013	0.0012	0.0085	0.0251	1.0
Adjusted Rhode Island VMT mix for 2002	0.6889	0.1920	0.0552	0.0271	0.0007	0.0011	0.0103	0.0247	1.0
Adjusted Rhode Island VMT mix for 2007	0.6193	0.2429	0.0726	0.0270	0.0003	0.0013	0.0124	0.0243	1.0
Adjusted Rhode Island VMT mix for 2009	0.5912	0.2631	0.0796	0.027	0.0002	0.0014	0.0132	0.0243	1.0

Chart A: Mobile 6 default vehicle registration fractions by year													
Type / Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
LDGV	0.0530	0.0706	0.0706	0.0705	0.0703	0.0698	0.0689	0.0676	0.0655	0.0627	0.0588	0.0539	0.0458
LDGT1 & 2	0.0581	0.0774	0.0769	0.0760	0.0745	0.0723	0.0693	0.0656	0.0610	0.0557	0.0498	0.0436	0.0372
LDGT3 & 4	0.0594	0.0738	0.0688	0.0640	0.0597	0.0556	0.0518	0.0482	0.0449	0.0419	0.0390	0.0363	0.0338
Type / Year	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**SUM**
LDGV	0.0363	0.0288	0.0228	0.0181	0.0144	0.0114	0.0090	0.0072	0.0057	0.0045	0.0036	0.0102	1.0000
LDGT1 & 2	0.0309	0.0249	0.0195	0.0147	0.0107	0.0085	0.0081	0.0078	0.0075	0.0072	0.0069	0.0359	1.0000
LDGT3 & 4	0.0315	0.0294	0.0274	0.0255	0.0237	0.0221	0.0206	0.0192	0.0179	0.0167	0.0156	0.0732	1.0000
Chart B: Annual MOBILE 6 mileage accumulation rates (miles/100,000 vehicles)													
Type / Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
LDGV	0.14910	0.14174	0.13475	0.12810	0.12178	0.11577	0.11006	0.10463	0.09947	0.09947	0.08989	0.08546	0.08124
LDGT1 & 2	0.19496	0.18384	0.17308	0.16267	0.15260	0.14289	0.13352	0.12451	0.11584	0.10752	0.09955	0.09194	0.08467
LDGT3 & 4	0.21331	0.19865	0.18500	0.17228	0.16044	0.14942	0.13915	0.12959	0.12068	0.11239	0.10466	0.09747	0.09077
Type / Year	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	
LDGV	0.07723	0.07342	0.06980	0.06636	0.06308	0.05997	0.05701	0.05429	0.05152	0.04898	0.04656	0.04427	
LDGT1 & 2	0.07775	0.07118	0.06496	0.05909	0.05356	0.04839	0.04357	0.03909	0.03497	0.03120	0.02777	0.02470	
LDGT3 & 4	0.08453	0.07872	0.07331	0.06827	0.06358	0.05921	0.05514	0.05135	0.04782	0.04454	0.04148	0.03863	
Chart C: Mileage accumulation rates for each vehicle fraction													
Type / Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
LDGV	790.23	1000.684	951.335	903.105	856.1134	808.0746	758.313	707.2988	651.5285	623.6769	528.5532	460.6294	372.0792
LDGT1 & 2	1132.718	1422.922	1330.985	1236.292	1136.87	1033.095	925.294	816.7856	706.624	598.8864	495.759	400.8584	314.9724
LDGT3 & 4	1267.061	1466.037	1272.8	1102.592	957.8268	830.7752	720.797	624.6238	541.8532	470.9141	408.174	353.8161	306.8026
Type / Year	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	
LDGV	280.3449	211.4496	159.144	120.1116	90.8352	68.3658	51.309	39.0888	29.3664	22.041	16.7616	45.1554	
LDGT1 & 2	240.2475	177.2382	126.672	86.8623	57.3092	41.1315	35.2917	30.4902	26.2275	22.464	19.1613	88.673	
LDGT3 & 4	266.2695	231.4368	200.8694	174.0885	150.6846	130.8541	113.588	98.592	85.5978	74.3818	64.7088	282.7716	
									Average annual miles per vehicle type				
										10,546	**LDGV**		
										12,504	**LDGT1 & 2**		
										12,198	**LDGT3 & 4**		